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CRYPTOGAMIE

BRYOLOGIE LICHENOLOGIE

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ON *NEOHODGSONIA* H. PERSS. (MARCHANTIALES, HEPATICAE)

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ABSTRACT — The morphological characteristics of *Neohodgsonia mirabilis* are reassessed and illustrated with recent, living specimens. Chromosome number, habitat and distribution are outlined. The monotypic genus *Neohodgsonia* is confirmed to belong to the family Marchantiaceae.

RÉSUMÉ — Les caractéristiques morphologiques de *Neohodgsonia mirabilis*, espèce rare de l'hémisphère sud, sont réétudiées et illustrées à l'aide d'échantillons vivants récoltés récemment. Le nombre chromosomique, l'habitat et la distribution sont précisés. Le genre *Neohodgsonia* est monotypique. Son appartenance à la famille des Marchantiaceae est confirmée. Son archégoniophore très particulier, à stipe ramifié et à segments du réceptacle non fusionnés, est expliqué par une séquence de division plus lente de la cellule apicale qui lui donne naissance.

Neohodgsonia is a monotypic genus. It occurs exclusively in New Zealand and Tristan da Cunha and is infrequent. Several imprecisions and inaccuracies are found in former descriptions that could place the genus in several phylogenetic lineages. Additional information on its morphology was needed for a forthcoming phylogenetic analysis of the Marchantiales. Recently, collected living samples made it possible to reassess and illustrate its characteristics, to add data formerly not included in its diagnosis, and to make a description comparable with that of the other marchantialean genera.

Neohodgsonia H. Perss.

Privately published leaflet. Stockholm. 14.1.1954.

= *Hodgsonia* H. Perss. Privately published leaflet. Stockholm. 22.12.1953, nom. illeg.

Type of the genus — *N. mirabilis* (H. Perss.) H. Perss. (*Hodgsonia m.* H. Perss., nom. illeg.), *Bot. Not.* 1954 : 40.

Type of the species — New Zealand. South Island, Fiordland, Doubtful Sound, track from Wilmot Pass to Deep Cove, montane forest belt, March 1, 1927, G. Einar & Greta Du Rietz 2035 (S).

= *Marchasta* Campb., *Trans. Roy. Soc. New Zealand* 81 : 485. 1954.

Type of the genus — *Marchasta areolata* Campb., *Trans. Roy. Soc. New Zealand* 81 : 485. 1954.

Type of the species — New Zealand. South Westland, Wahio, beside the track to Alex Knob, 300m, *Weinmannia-Metrosideros* forest, 9.10.1953, *Campbell 531* (MPN).

DESCRIPTION (in italics, the corrections or additions to former descriptions) — Thallus fleshy, glossy on the upper side, not drought-tolerant, 8-10 mm wide, not tinged with purple, branching close, dichotomous and apical after gametangiophore initiation (from ventral side of thallus); *no median band*; margins wide, translucent, wavy, unistratose, of 5-6 cell rows, walls thin. Epidermal cells in single layer, *thin-walled without thickened angles*, $40-56 \times 30-40 \mu\text{m}$. Epidermal pores slightly elevated above epidermis, compound, $40-56 \mu\text{m}$ diam., surrounded by 4 rings of cells, 2-3 above epidermis, 1-2 projecting into air-cavities, outermost ring of 4 cells with a ring of translucent, collapsed cells, innermost ring of 4 cells with bulging walls; radial walls thin. *One layer of incurved air-cavities (in transverse section seen as 2-4 layers)*, slightly bulging on dorsal thallus side, each with an epidermal pore; partitions 2-layered; *without filaments*; *with stalked mucilage papillae, especially numerous at bottom*. The mucilage, becoming brownish in older parts of thalli and accumulating at the bottom of air-cavities, is seen as brown strips in the median part of underside of older thalli. Stalk cell of papillae with chloroplasts. Basal tissue in 15-22 cell layers, walls not pitted; *no mucilage cavities*; *no sclerotic cells*; *oil-cells containing a single, refringent oil-body composed of numerous small and large oil-drops*. Rhizoids smooth, of two types: $24-26 \mu\text{m}$ wide, thin-walled, or narrower, $10-13 \mu\text{m}$ wide, sinuose, with slightly thickened walls. Scales in two rows, hyaline at thallus apex, brownish in older parts, rounded or obtuse apically, without appendage, without oil-cells but with hyaline marginal mucilage papillae becoming brownish on older scales (fig. 1 : 1-11, fig. 4 : A-C, fig. 6 : A, C-D).

Asexual multiplication by discoid gemmae, developing in cup-shaped gemmae cups, found on sterile and fertile thalli. Gemmae cups with lobed-ciliate margins; lobes with a row of 3-5 cells apically and cilia of 1-2 cells; *1-2-celled papillae at bottom of outer side*. Gemmae with a single growing point, overarched by mucilage hairs. *No mucilage hairs at bottom of gemmae cups* (fig. 1 : 12-13, fig. 4 : D-F, fig. 5 : A).

Chromosomes very small, $n=9$ (fig. 6 : E).

Monoecious. Antheridia in *terminal*, stalked antheridiophore with a disciform, often slightly asymmetric, sometimes faintly and irregularly lobed receptacle. Stalk 4-10 mm long, with 1 assimilatory strip, *1 rhizoid furrow* and smooth rhizoids. Receptacle 2.5-4.2 mm diam., with compound pores, similar to those of thallus, and ostioles surrounded by 6-8 cells on dorsal side; *no papillae*; membrane wide, bordered by smaller, thin-walled cells. Antheridial cavities *without paraphyses at bottom but with some mucilage papillae on the side walls*. Antheridia ovoid, with a *stalk of 5-6 tiers of cells*. Scales underneath receptacle and along stalk conspicuous, rounded or obtuse apically, without appendage and usually without oil-cells, with

marginal mucilage papillae. Occasionally, antheridia are found in androgynous receptacles, with male branches among the female segments (fig. 2 : 1-9, fig. 5 : B).

Archegonia in terminal, stalked branch system with 2-4 dichotomies. Stalk 5-20 mm long, with 1 assimilatory strip and 1 rhizoid furrow, 1-3 times branched; near each branching, the rhizoid furrow dividing into 2; *rhizoids smooth*. Receptacles at the 2-8 branch tips, each bi- (tri-) lobed, the whole branch system of 3-10 mm diam., theoretically with 4-16 (usually 4-12) fertile segments; segments 2-3 mm long and 1.5-2 mm wide, with compound, raised pores on dorsal side, of the same structure than thallus pores, and one layer of large air-cavities with *mucilage papillae*; *involucre thin, 1-2-stratose, hyaline, with oil-cells, bivalve, with entire margins, connate until sporophyte maturity and opening then from near top of segment towards bottom*. Scales along ventral side of stalk and segments hyaline, becoming later brownish, rounded or obtuse apically, without appendage, some with a single oil-cell, with mucilage papillae on margins. Archegonial cavity with 4-10 archegonia, without paraphyses but with *mucilage papillae on the side walls*. Each archegonium surrounded by a campanulate, hyaline pseudoperianth developing from the short archegonial stalk. Archegonial neck of 6 tiers of cells, 8-10 cell rows long, with 6-8 neck canal cells. *Calyptra becoming up to 4-layered after fertilization* (according to Campbell (1954b), 8-layered, partly resorbed during spore maturation) (fig. 3 : 1-13, fig. 5 : C-D, fig. 6 : B).

Sporophyte 1 per segment. Embryo-type filamentous (according to Campbell 1954b). Mature sporophyte with foot and short seta, about 10-12 cells across diam. (according to Campbell 1954b). Capsule globose, not exerted at maturity; *walls with annular thickenings, opening by 4-5 irregular valves up to 1/3 of capsule length. Spore/elater ratio superior to 4/1*. Elaters with two helical bands, $280-600 \times 6-8 \mu\text{m}$. Spores $20-24 \mu\text{m}$ diam., *numerous (about 10 000 per capsule)*, with *trilete scar, irregularly pitted on proximal and distal faces* (fig. 5 : E-H).

Spore germination (according to Campbell (1954b) and Inoue (1961)) by proximal face; germ tube and germ rhizoid of *Neohodgsonia*-type, similar to that found in several *Marchantia* species.

HABITAT — In New Zealand : in montane forests in wetter parts of the country, at altitudes of between 490 and 1180 m. It is usually found under *Nothofagus menziesii* forest but is also found under *Nothofagus fusca* forest and *Weinmannia racemosa* — *Metrosideros umbellata* forest. Accompanying species are the ferns *Histiopteris incisa*, *Hypolepis rufobarbata* and *Polystichum richardii*, the mosses *Atrichum androgynum*, *Wijkia extenuata*, *Hypnodendron spininervium*, *Distichophyllum crispulum*, *Rhizogonium distichum*, *Ditrichum cylindrocarpum* and *Campylopus purpureocaulis*, the hepatics *Aneura alterniloba* and *Telaranea gottscheana* and the herb *Cardamine debilis*. The usual substrate is well drained soil, most often the mineral soil attached to the root plate of fallen trees. It also occurs on steep banks, both on mineral and humic soils, in colonies up to one square meter.

DISTRIBUTION — New Zealand : North Island (Taranua Ranges), South Island (Nelson, Westland, Southland). Reported from Tristan da Cunha : Inaccessible Is, Nightingale, Gough (Wace & Dickson 1965).

SPECIMENS SEEN — NEW ZEALAND. NORTH ISLAND. WELLINGTON : Taranua Ranges, Mt Holdsworth, *Butler* 2583 (CHR), *Melville* 5555 (CHR), *Hay* s.n. (CHR) ; Tabletop, *Zotov* s.n. (CHR), near Field Hut, *Zotov* s.n. (CHR), Waiotauru Valley, *Brownsey* s.n. (WELT), *Sneddon* s.n. (WELT). SOUTH ISLAND. NELSON : Mt Arthur, Flora Saddle, *Macmillan* s.n. (CHR), *Given* 64419 (CHR), *Glenny* 4477 (WELT) ; Marino Mountains, Fyfe River, *Glenny* 5546 (WELT), Wangapeka River near Wangapeka Saddle, *Macmillan* 71/36 (CHR), *Glenny* 5587 (WELT). WESTLAND : Glasgow Range, *Glenny* 5933 (WELT) ; Pororari River, *Fife* 6505 (CHR) ; Wilberg Range, Harold Stream, *Macmillan* 74/26 (CHR), Wilberg Range, Flora Stream, *Glenny* 4964 (WELT) ; Northern Olivine Range, Carl Creek, *Glenny* 5752 (WELT). SOUTHLAND : Hollyford Valley, near Howden Hut, *Burrell, Scott & Taylor* s.n. (CHR), *Macmillan, Morice & Taylor* s.n. (CHR) ; track to Lake Marion, *Morice & Taylor* s.n. (CHR) ; Milford Track near Sandfly Point, *Morice, Schuster, Wylie & Taylor* s.n. (CHR) ; Lake Manapouri, head of lake, *Simpson* s.n. (CHR), Wilmot Pass, *Macmillan* s.n. (CHR).

DISCUSSION — *Neohodgsonia* has all characteristics that define the family Marchantiaceae : a single layer of air-cavities, each with a compound epidermal pore ; terminal, stalked antheridiophores and archegoniophores, the stalk of the archegoniophore elongating before fertilization of archegonia ; sporophytes protected by a calyptra, a campanulate pseudoperianth opening irregularly at top, and an involucre.

The flavonoid pattern of *Neohodgsonia*, of intermediate complexity (Campbell *et al.* 1979), shows affinities to *Lunularia* Adans., *Conocephalum* Hill and subg. *Marchantia*, and places the genus in the Marchantiaceae (including also the genera *Conocephalum* and *Lunularia* for Campbell *et al.*).

Many of the characteristics of *Neohodgsonia* are not found in any of the other genera of the Marchantiales : very large, obliquely oriented air-cavities with bistratose partitions and mucilage papillae ; archegoniophore stalks with well-developed air-cavities that preserve the generalized form of the thallus, with decurved margins, median strand of rhizoids, dorsal air-cavities and large ventral scales ; and, most striking, juxtaposed segments in the archegoniophore, not yet condensed into a single receptacle, preserving the obviously dichotomous origin of its partitions. These characteristics were postulated as primitive by Schuster (1992) who thought the genus to belong, together with *Lunularia*, to the most primitive forms found in the suborder Marchantiineae (Marchantiales with stalked receptacles), despite some advanced features as asexual reproduction by gemmae and small spores.

An explanation for the unusual structure of the archegoniophore in *Neohodgsonia* could imply a slower division rate of the apical cell involved in its development. This cell is located in the primordium of the archegoniophore and divides after contraction of the primordium at its junction with the thallus in all representatives of the suborder Marchantiineae (Leitgeb 1881). Its subsequent

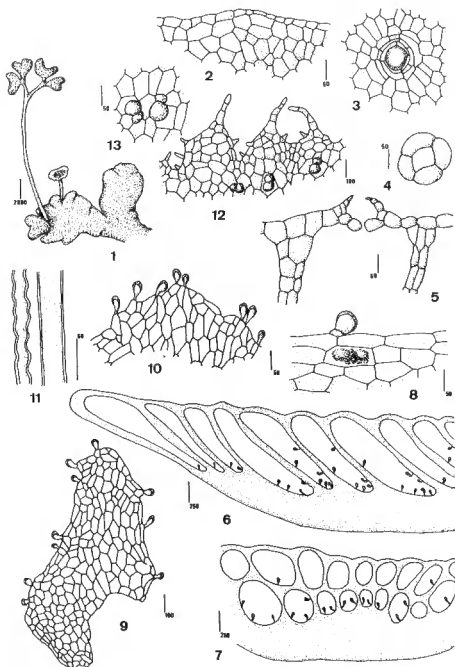
divisions, nearly simultaneous in the other Marchantiaceae, could be delayed and spaced in time in *Neohodgsonia*, resulting in receptacles with independent, shortly stalked segments (Bischler 1987). Whether this character is primitive remains controversial.

The fully developed archegoniophore in other Marchantiaceae as, for instance, in *Marchantia* L. and *Preissia* Corda, may occasionally have branched stalks, but such stalks probably originate from two apical cells differentiating close to each other at thallus apex. A double number of rhizoid furrows in the fused part of stalk is present, becoming single in each branch (Bischler 1987). Homology with the stalks in *Neohodgsonia* is questionable, as the rhizoid furrow in this genus is single at the stalk bottom and divides only near the branching point.

The phylogenetic position of *Neohodgsonia* remains controversial. Whether it is one of the most primitive forms in the Marchantiaceae, as stated by Schuster (1992), or a sister group of *Marchantia*, close to the most derived genera in the Marchantiales, remains uncertain.

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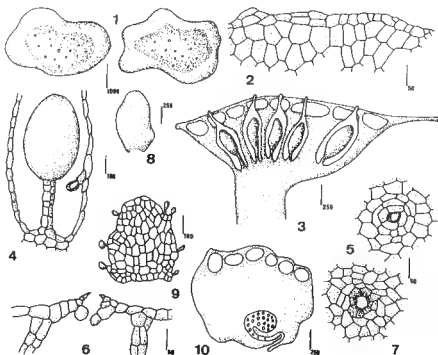


Fig. 2 — *Neohodgsonia mirabilis*. Antheridiophore. 1 : male receptacles, 2 : margin of receptacle, 3 : transverse section of receptacle, with air-cavities at top and antheridial cavities below, 4 : antheridial cavity with stalked antheridium and mucilage papillae on the side wall, 5 : pore, front view, dorsal side of receptacle, 6 : transverse section of pore, 7 : antheridial ostiole, front view, dorsal side of receptacle, 8 : scale of receptacle, 9 : scale of stalk, 10 : transverse section of stalk (New Zealand, *Glenny 5587*; scale bars in μm).

Fig. 1 — *Neohodgsonia mirabilis*. Gametophyte. 1 : thallus with antheridiophore and archegoniophore, 2 : thallus margin, 3 : epidermal pore, front view, 4 : epidermal pore, underside, 5 : transverse section of epidermal pore and underlying air-cavities, with 2-layered partitions, 6 : longitudinal thallus section, showing the single layer of air-cavities with papillae, 7 : transverse thallus section in the central part, with air-cavities apparently in 2 layers, 8 : bottom of air-cavity with papilla and basal tissue with an oil-cell, 9 : scale, 10 : apex of scale, with mucilage papillae, 11 : the two types of rhizoids, 12 : margin of gemmae cup, 13 : papillae on the outer side of gemmae cup (New Zealand, *Glenny 5546*; scale bars in μm).

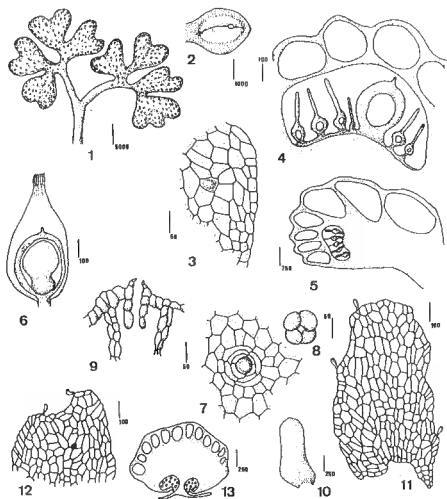


Fig. 3 — *Neohodgsonia mirabilis*. Archegoniophore. 1 : female receptacle, 2 : segment from underside, with involucre, 3 : margin of involucre, 4 : transverse section of segment, showing some unfertilized and a fertilized archegonium, 5 : longitudinal section of segment, with unfertilized archegonia, 6 : young sporophyte, surrounded by a calyptra and a pseudoperianth, 7 : epidermal pore of dorsal side of segment, front view, 8 : epidermal pore, underside, 9 : epidermal pore with underlying air-cavity, transverse section, 10 : scale of stalk, 11 : scale of underside of segment, 12 : apical part of scale, with an oil-cell and mucilage papillae, 13 : stalk, transverse section, at level of branching point (New Zealand, *Glenny 5587*; scale bars in μm).

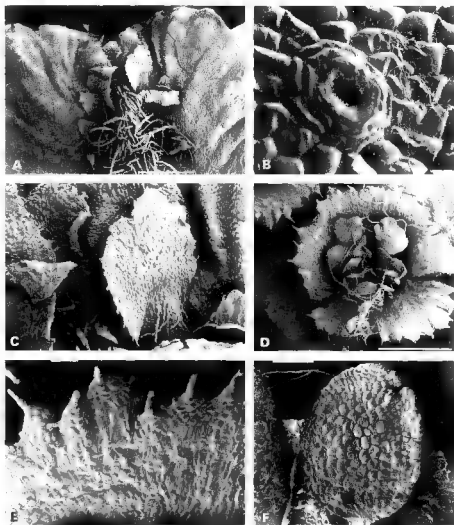
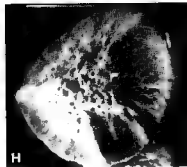
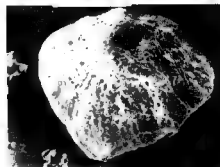
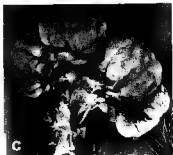


Fig. 4 — *Neohodgsonia mirabilis*, SEM photographs. A : arrangement of scales on ventral thallus side, B : compound epidermal pore, with innermost ring of cells collapsed, C : scale, without appendage, with marginal papillae, D : gemmae cup, some rhizoids of gemmae outgrown, E : lobed-ciliate margin of gemmae cup, F : gemma, with single growing point (New Zealand, Glenny 5546 ; scale bars : A, D = 1 mm, B = 10 μ m, C, E, F = 100 μ m).



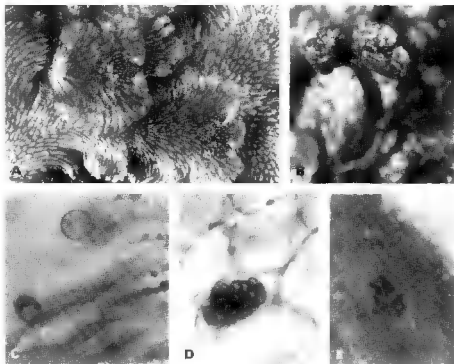


Fig. 6 — *Neohodgsonia mirabilis*, light microscope photographs. A : thalli, B : young archegoniophore, C : papillae in air-cavity, D : oil-cell in basal thallus tissue, E : mitotic chromosomes from thallus apex (New Zealand, *Glenny 5546*; A = 5 x, B = 7 x, C = 1000 x, D = 750 x, E = 4800 x).

Fig. 5 — *Neohodgsonia mirabilis*, SEM photographs. A : mucilage papillae around growing point of gemma, B : margin of male receptacle, C : young female receptacle, the lobes not yet spread out, D : bilobed segment of female receptacle, with raised, compound pores on dorsal side, E : annular thickenings of capsule wall, F : part of an elater, with two helical bands, G : spore, distal face, H : spore, proximal face (A-D : New Zealand, *Glenny 5587*, E-H : New Zealand, *Schuster 52690* (TNS); scale bars : A, E, G, H = 10 μ m, B = 100 μ m, C, D = 1 mm, F = 1 μ m).

PYCNOCONIDIAL TYPES AND THEIR PRESENCE IN CETRARIOID LICHENS (ASCOMYCOTINA, PARMELIACEAE)

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ABSTRACT — The pycnoconidia in about 70 cetrarioid lichen species have been investigated. Five main types are recognized: bacillariform, bifusiform, citrifiform, filiform and sublageniform pycnoconidia. The largest morphological variation is found within the bifusiform and citrifiform types. The variation and presence of different types within cetrarioid lichens are described and discussed.

RÉSUMÉ — Les pycnoconidies d'environ 70 lichens cétrarioides ont été étudiés. 5 types principaux de pycnoconidies sont distingués: bacilliforme, bifusiforme, citrififorme, filiforme et sublagéniforme. Les variations morphologiques les plus importantes s'observent à l'intérieur des types bifusiforme et citrififorme. La présence des différents types et de leurs variations dans les lichens cétrarioides sont décrits et discutés.

INTRODUCTION

The cetrarioid lichens belong to different evolutionary lines (Kärnefelt *et al.* 1992). Basically these taxa have been characterized by marginally situated apothecia and pycnidia. In addition, an erect foliose thallus with a dorsiventral structure is also characteristic for the cetrarioid group (Randlane & Saag 1993). Several separate genera have recently been described (Brusse & Kärnefelt 1991, Kurokawa & Lai 1991, Kärnefelt *et al.* 1993, Kärnefelt & Thell 1993, 1994, Mattsson & Lai 1993, Randlane *et al.* 1994). Furthermore, a number of cetrarioid species have changed generic position (Randlane & Saag 1992, Randlane *et al.* 1995, Thell 1995, Thell *et al.* 1995a, b, c). More than twenty cetrarioid genera and species groups are recognized in modern taxonomy but the affinities of some taxa are still uncertain.

The cetrarioid lichens can be divided into three groups based on characters in asci and ascospores :

1. Genera with narrowly clavate asci and ellipsoid ascospores: *Arctocetraria* Kärnef. & Thell, *Cetraria* Arch., *Cetrariopsis* Kurok., *Cetrellopsis* Lai, *Flavocetraria* Kärnef. &

Thell, *Masonhalea* Kärnef. and *Nephromopsis* Müll. Arg. The genus *Coelopogon* Brusse & Kärnef. probably is placed here basically on morphological grounds. Apothecia and pycnidia have unfortunately not been observed.

II. Genera with narrowly clavate asci and globose or subglobose ascospores: *Ahtiana* Goward, *Allocetraria* Kurok. & Lai, *Esslingeriana* Hale & Lai, *Tuckermannopsis* Gyelnik and *Tuckneraria* Randl. & Thell. Several taxa have been transferred to *Tuckermannopsis* (Lai 1980, Hale 1987, Kärnefelt *et al.* 1993). Some of these entities are obviously not closely related to the type species, *T. ciliaris* (Kurokawa 1990, Mattsson & Lai 1993, Thell 1995, Thell *et al.* 1995b, c). In this investigation only taxa with globose or subglobose ascospores distributed mainly in North America and northern Eurasia have been included.

III. Genera and species groups with broadly clavate asci and ellipsoid ascospores: *Asahinea* W. Culb. & C. Culb., *Cetrariella* Kärnef. & Thell, *Cetrelia* W. Culb. & C. Culb., *Melanelia* Essl. (the *Melanelia commixta* group¹), *Nimis* Kärnef. & Thell, *Parmelaria* Awasthi, *Platismatia* W. Culb. & C. Culb., *Vulpicida* J.-E. Mattsson & M.-J. Lai, the *Cetraria californica* group² and the *Cetraria fendleri* group³.

Five main types of pycnoconidia are recognized within the cetrarioid group: 1. bacillariform, 2. bifusiform, 3. citriform, 4. filiform and 5. sublageniform (Fig. 1). Vobis (1980) did not mention sublageniform as a main pycnoconidial type but four of the seven main types described by him are present in cetrarioid lichens. Krog (1982) includes one more type, uniform, from the parmelioid group, present in the genus *Punctelia*. Lindsay (1859) investigated pycnidia and pycnoconidia in the cetrarioid species known at that time, and many of his observations are still valid.

Pycnoconidia have been found in about 70 of the 120 cetrarioid species listed by Randlane & Saag (1993) in material from a large number of herbaria. Pycnidia are unknown in *Coelopogon* and *Cetrariopsis*. A list of the pycnoconidial types within the cetrarioid genera is urgently needed, since the terminology is very confusing and many alternative conceptions for the same type have been used.

Pycnoconidia have been referred to as conidia, pycnosporos, pycnidiosporos, spermatia, macroconidia and microconidia (microspores). However, pycnoconidia of two different sizes were known only from three lichen genera until now. Microconidia are always one-celled and are present in most lichen genera, but in *Lecanactis*, *Micarea* and *Porina*, macroconidia are also developed, two-celled in *Porina* (Henssen & Jahns 1973, Coppins 1983). Macroconidia in contrast to microconidia serve as vegetative propagules for the fungal part of the lichen. Furthermore, from the genus *Micarea* mesoconidia are also reported. These obviously function as asexual diaspores which is presumably the case also for the

¹ *Melanelia agnata*, *M. commixta*, *M. culbersonii* and *M. hepaticon*.

² "*Cetraria*" *californica* and "*C.*" *merrillii*.

³ "*Cetraria*" *coralligera*, "*C.*" *fendleri*, "*C.*" *sepincola*, "*C.*" *subfendleri* and "*C.*" *weberi*.

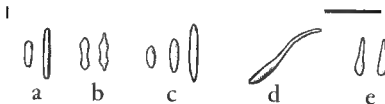


Fig. 1. Pycnoconidial main types in cetrarioid lichens: a. bacillariform, b. bifusiform, c. citriform, d. filiform, e. sublageniform. Bar = 10 μ m.

macroconidia in this genus (Coppins 1983). I have chosen to use the longer word pycnoconidia instead of conidia in this study mainly for two reasons: The first reason is that I have frequently used this term in my previous papers. Secondly, I wanted to stress the functional difference between conidia formed in pycnidia and true conidia, which are usually not developed in pycnidia and serve as vegetative propagules. Only microconidia are found in cetrarioid lichens. The fact that microconidia function as spermatia and can become attached to trichogynes has been noted many times (Stahl 1877, Baur 1898, Admadjian 1966, Jahns 1970, Honegger 1984 a, b, Culberson *et al.* 1988). Microconidia have therefore been called spermatia rather than conidia by some (e. g., Tulasne 1852, Lindsay 1859, 1872, Glück 1899, Johnson 1954, Honegger 1984 a), and the structures in which they are formed have sometimes been called spermogonia rather than pycnidia (Lindsay 1859, 1872, Glück 1899, Poelt & Petutschnig 1992, Poelt & Nash 1993). Some species that develop apothecia, however, apparently lack pycnidia (e. g., in the genus *Cetrariopsis*). Here, apogamy must be the explanation for fertilization of the ascogon (Moreau & Moreau 1928, Letrouit-Galinou 1973).

PYCNOCONIDIAL TYPES

1. Bacillariform pycnoconidia (including bacillariform, rod shaped, staff shaped and cylindrical types)

True bacillariform pycnoconidia are very rare in cetrarioid lichens. Bacillariform conidia are totally straight and uniform and are called cylindrical or rod-shaped by some authors. They are characteristic for the monotypic genus *Masonhalea*, where they measure about $5 \times 0.75\text{--}1 \mu\text{m}$ and have blunt ends (Kärnefelt 1977, Kärnefelt *et al.* 1992) (Fig. 3). Pycnoconidia of the same shape and size are rarely also found in *Ahtiana pallidula* (Thell *et al.* 1995c).

In *Tuckermannopsis inermis* and *T. subalpina*, several different types have been seen (Table 1). In these species, the bacillariform type are 8-10 μm long (Kärnefelt *et al.* 1993).

Rod-shaped or straight pycnoconidia up to 10 μm long have also been reported from the genera *Asahinea* and *Parmelaria* (Culberson & Culberson 1965, Awasthi 1987). However, in *Parmelaria* I have recognized them as typically citriform (see below).

2. Bifusiform pycnoconidia

Bifusiform pycnoconidia have two more or less distinct, apical or subapical swellings (Figs. 4-5). This type is the most common within cetrarioid lichens and is represented by two different shapes of about the same size (c. 5-7 μm), partly overlapping each other:

a. dumb-bell shaped (biclaviform or bipolar).

b. disc-bar shaped

Dumb-bell shaped pycnoconidia, characterized by strictly apical swellings and the ends more or less rounded to fusiform, are very common (Fig. 4). All pycnoconidia found in the genera *Flavocetraria*, *Nephromopsis*, *Cetrellopsis*, *Esslingeriana*, and *Tuckneraria* are dumb-bell shaped, and they are also characteristic of *Ahtiana*, *Arctocetraria*, *Melanelia*, *Tuckermannopsis*, the *Cetraria fendleri* group, and many other genera in the Parmeliaceae (Kärnefelt *et al.* 1992, 1993, 1994, Randlane *et al.* 1994, 1995, Thell *et al.* 1995c).

Typically disc-bar shaped conidia with sharp ends and subapical swellings are characteristic for the *Cetraria californica* group but are frequently also seen in *Ahtiana* and in the *Cetraria fendleri* group. This shape is very common within many parmelioid genera such as the brown Parmeliae (Thell 1995).

3. Citriform pycnoconidia (including fusiform and ellipsoid types)

This type includes all pycnoconidia with the central part broader than the ends (Figs. 6-8). The width in the central part is about 1-1.5 μm in all citriform pycnoconidia, but they could be divided into three shapes or length classes:

a. citriform: c. 3-5 μm long.

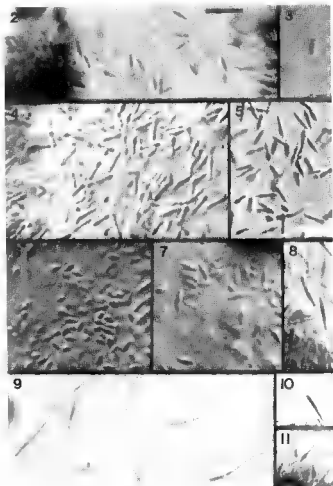
b. oblong citriform: c. 5-7 μm long.

c. very oblong citriform: c. 8-10 μm long.

Typically lemon-shaped, citriform conidia (Fig. 6), 3-5 μm long, have been found only in a few cetrarioid species, *Melanelia commixta*, *Parmelaria thomsonii*, *Vulpicida canadensis* and *V. viridis* (Kärnefelt *et al.* 1992, Mattsson & Lai 1993).

Taxon	bac.	bif., dum.	bif., dis.	citr., nor.	citr., obl.	citr., v ob.	fil.	subl.	nr. sp.
<i>Ahtiana</i>	(1)	+	+		(1)			(1)	3
<i>Allocetraria</i>							+		8
<i>Arctocetraria</i>		+			(1)				2
<i>Asahinea</i>	+?								2
<i>Esslingeriana</i>		+							1
<i>Cetraria</i>					+			(1)	16
<i>Cetrariella</i>								+	2
<i>Cetrelia</i>		+							17
<i>Cetreliaopsis</i>		+							5
<i>Flavocetraria</i>		+							2
<i>Masonhalea</i>	+								1
The <i>Melanelia commixta</i> g.		+		(1)	(1)			(1)	4
<i>Nimisla</i>						+			1
<i>Nephromopsis</i>		+							9
<i>Parmelaria</i>				+					2
<i>Platismatia</i>								+	10
<i>Tuckermannopsis</i>	(2)	+				(2)		(2)	9
<i>Tuckneraria</i>		+							5
<i>Vulpicida</i>				+				+	6
The <i>Cetraria californica</i> g.			+						2
The <i>Cetraria fendleri</i> group		+	+						5

Table 1. Cetrarioid genera and species groups and their main pycnoconidial types marked with + and their approximate number of species. The number of species within a genus or species group with a diverging pycnoconidial type is indicated in brackets. Note that several types can be present in the same species. The question mark indicate literature data.



Figs. 2-11. Pycnoconidial variation within cetrarioid lichens. 2. Pycnoconidial variation within the same pycnidium in *Ahtiana pallidula*, U.S.A., California, Thoren 2823 (SF DU). 3. Bacilliform pycnoconidium in *Masonhalea richardsonii*, U.S.A., Alaska, Viereck & Jones 5634 (LD). 4. *Melanelia hepatizon*, dumb-bell shaped bifusiform pycnoconidia, Canada, Ontario, Wetmore 29004 (GZU). 5. *Cetraria merrillii*, disc-bar shaped bifusiform pycnoconidia, Canada, B.C., Kärnefelt 8155-2 (LD). 6. Typically citriform pycnoconidia, *Vulpicida canadensis*, Canada, B.C., Brodo 7804 (CANL). 7. Oblong citriform pycnoconidia, *Cetraria aculeata*, Sweden, Blekinge, Svanlund 1871 (LD). 8. *Nimisla fuegiae*, pycnoconidia of a very oblong citriform type, Argentina, Tierra del Fuego, Poelt 10-8P (GZU). 9. Slightly sublageniform filiform pycnoconidia present in *Allocetraria globulans*, Nepal, Langtang, Miehe 4403 (GZU). 10. *Cetrariella delisei*, Sweden, Värmland, Sundell 26.9.1970 (LD). 11. Sublageniform conidia, *Vulpicida juniperinus*, Sweden, Jämtland, Öhrstedt 23.11.1936 (LD) Bar in Figs. 2-11 - 10 μ m.

The oblong citriform pycnoconidia in *Cetraria* were called rod-shaped by Kärnefelt (1979, 1986) and Kärnefelt *et al.* (1992). To separate them from clearly rod-shaped pycnoconidia present in *Masonhalea richardsonii*, we introduced the term "oblong citriform" for this pycnoconidial type (Fig. 7). This was done in connection with the delimitation of the genus *Cetraria* (Kärnefelt *et al.* 1993). Oblong citriform pycnoconidia are rarely present as well in *Arctocetraria andrejevii*, *Ahtiana pallidula* and *Melanelia commixta* (Table 1).

Very oblong citriform pycnoconidia are characteristic for the monotypic genus *Nimisia* (Fig. 8) and they occur rarely in *Tuckermannopsis inermis* and *T. subalpina* (Kärnefelt & Thell 1993, Kärnefelt *et al.* 1993).

4. Filiform (thread shaped) pycnoconidia

Filiform pycnoconidia are always longer than 10 μm . Within cetrarioid lichens this type is totally restricted to the genus *Allocetraria*, where they are 10-22 μm long, rather bent and somewhat thicker at one end, i. e. slightly sublageniform (Fig. 9). Filiform pycnoconidia of the same length also occur in several parmelioid genera but differ from those in *Allocetraria* in being straight and rod-shaped (Krog 1982).

5. Sublageniform (bottle-shaped, clavate) pycnoconidia

Sublageniform pycnoconidia, present in several genera that are probably not closely related, are characterized by one end pointed and one the other end thickened. At least two types can be recognized, perhaps with different origins. Plainly bottle-shaped pycnoconidia are characteristic of *Platismatia* and are also present in four species of *Vulpicida* (Fig. 11). Another variant of sublageniform pycnoconidia is rod-shaped but has only one pointed end (Fig. 10). Such pycnoconidia are characteristic for the genus *Cetrariella* and are rarely observed in *Tuckermannopsis inermis* and *T. subalpina* (Kärnefelt *et al.* 1993).

DISCUSSION AND CONCLUSIONS

There is often a clear correlation between the pycnoconidial type and other characters used for generic delimitation within cetrarioid lichens. Good examples are the related genera *Cetrelia*, with bifusiform pycnoconidia, and *Platismatia*, with pycnoconidia of the sublageniform type (Krog 1982). The well delimited genus *Allocetraria* is characterized by a unique type of filiform pycnoconidia (Thell *et al.* 1995b). Disc-bar shaped pycnoconidia are characteristic for the *Cetraria californica* group and are also present in the presumably related genera *Cornicularia*, *Nodobryoria*, and *Pseudephebe* (Fig. 5). Four of the five cetrarioid genera with globose or subglobose ascospores, i. e. *Ahtiana*, *Esslingeriana*, *Tuckermannopsis* and

Tuckneraria are characterized by dumb-bell shaped pycnoconidia (Fig. 4). The two monotypic genera *Masonhalea* and *Nimisia* both have unique pycnoconidial types (Figs. 3, 8).

Sometimes, however, pycnoconidial morphology seems to be rather variable. In the presumed monophyletic genera *Ahtiana* and *Vulpicida*, two or more different pycnoconidial types have been observed, even in the same pycnidium (Fig. 2). True citriform pycnoconidia are found in three not so closely related cetrarioid genera. This is presumably an example of convergent evolution. Several intermediate forms between bifusiform and citriform pycnoconidia are observed in the North American material of *Melanelia commixta* (Thell 1995). The citriform pycnoconidia in *Vulpicida canadensis* and *V. viridis* may have evolved from sublageniform (bottle-shaped) pycnoconidia present in all other *Vulpicida*-species by loosing the bottleneck (Figs. 6, 11). The third genus with this pycnoconidial type, *Parmelaria* seems to have an isolated position within cetrarioid genera (Awasthi 1987). Pycnidial and pycnoconidial characters are still not being included enough in modern classifications within the Parmeliaceae. For two species in *Alloctetraria*, *A. globulans* (Nyl.) Thell & Randl. and *A. oakesiana* (Tuck.) Thell & Randl., the filiform pycnoconidial shape solved the systematic position (Thell *et al.* 1995b). These two species were earlier included in *Cetraria* or *Tuckermannopsis*. Unfortunately, some cetrarioid genera and species lack pycnidia as well as apothecia. It is sometimes difficult to classify such species in a phylogenetically meaningful way since morphology and cortex anatomy are often variable, and chemistry often adds too little information.

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**BUELLIA VOUAUXII CALATAYUD & BARRENO SP. NOV.,
A NEW LICHENICOLOUS FUNGUS ON
RHIZOPLACA MELANOPHTHALMA (RAMOND)
LEUCKERT & POELT FROM THE CANARY ISLANDS**

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ABSTRACT — *Buellia vouauxii* Calatayud & Barreno sp. nov. is described from Las Cañadas del Teide National Park (Tenerife, Canary Islands). The new lichenicolous fungus, which is a commensal of *Rhizoplaca melanophthalma* (Ramond) Leuckert & Poelt., is discussed in relation to other *Buellia* species.

KEY WORDS : lichenicolous fungi, lichens, Canary Islands, *Buellia*.

INTRODUCTION

In 1911, Pitard & Harmand published a paper entitled "Contribution à l'étude des lichens des Îles Canaries" (Pitard & Harmand 1911). This study considerably increased the number of species known from the Canarian Archipelago, and many new taxa were described. At the end of this contribution, a list of 13 non-lichenized, lichenicolous species, identified by L. Vouaux, was added. Since then, records of some lichenicolous fungi from this territory have been reported sporadically (e.g. Vouaux 1912-1914, Hawksworth 1982); those previous to 1989 have been picked up in Clauzade *et al.* (1989). Other more recent finds are included in Santesson (1994a, 1994b) and in Calatayud *et al.* (1995).

During the course of a study on some lichens and lichenicolous fungi from Las Cañadas del Teide National Park (Tenerife), a commensalistic *Buellia* species growing on *Rhizoplaca melanophthalma* was examined. Its particular life strategy, in combination with its anatomical characters put in evidence that it was an undescribed taxon. This paper deals with the description of that species, named *Buellia vouauxii* in honour of L. Vouaux, for his earlier contribution to our knowledge of lichenicolous fungi from the Canary Islands.

METHODS

The material was examined with an Olympus SZ dissecting microscope and an Olympus BH-2 light microscope, provided with phase contrast. Microphotographs were taken on AGFAPAN 100 film. The temporary erythrosin mountant was used for the study of the conidiomatal structures. The exciple and ascospore types follow Scheidegger (1993). The typology of the conidiomatal structures is in accordance with that proposed by Vobis & Hawksworth (1981).

DESCRIPTION

***Buellia vouauxii* Calatayud & Barreno sp. nov.**

Species non-lichenisata, lichenicola. Apothecia lecideina, singularia, nigra, 0.4-1 mm lata. Excipulum brunneum, typo aethalea. Epithecium atrobrunneum. Hymenium hyalinum, 75-110 µm altum; gelatina hymenii jodo caerulescens. Hypothecium brunneum ad atrobrunneum. Paraphyses septatae, ramosae, superne incrassatae et atrobrunneae. Asci typo Lecanora, in apicibus jodo caerulescentes, 50-65 µm longi et 15-18 µm crassi, 8-sporei. Ascosporae uniseptatae, fuscae, 16-20 × 7-10 µm, typo Physconia. Conidia bacilliformia, 4-5 × 1 µm.

Typus : Spain, the Canary Islands, Tenerife, Las Cañadas del Teide National Park, Roques de García, commensalistic on *Rhizoplaca melanophthalma*, on volcanic rocks, 2125 m alt., 23 September 1993, V. Calatayud 7566 (VAB-lich.-holotypus)

Species non-lichenized, lichenicolous. Apothecia lecideine, dispersed, roundish, black, 0.4-1 mm in diam., disc flat or slightly convex and epruinose, margin thin or almost inconspicuous. Excipulum radially formed by a textura angularis, brown pigmented, aethalea type. Epithecium dark brown, K-, N-. Hymenium colourless, 75-110 µm high; hymenial gelatine I+ blue. Hypothecium brown to dark brown. Hamathecium of paraphyses, ca. 2 µm in diam., strongly branched in the upper third, apices swollen and pigmented, 4-7 µm in diam., with a dark brown cap. Asci 8-spored, clavate, tholus I + blue, of the Lecanora type, 50-65 × 15-18 µm. Ascospores brown, 1-septate, ellipsoid, frequently curved, of the Physconia type, 16-20 × 7-10 µm, surface ornamented. Conidiomata pycnidia, immersed, of the Anaptychia type; wall brown, formed by a textura angularis, cells 4-6 µm in diam.; conidia bacilliform, 4-5 × 1 µm.

Ecology and distribution : The new species is known only from the type locality, where the host lichen, *Rhizoplaca melanophthalma*, was quite abundant, growing together with *Rhizoplaca chrysoleuca* (Sm.) Zopf. This locality is at more than 2100 m of altitude, in Las Cañadas del Teide National Park, close to the natural monument called El dedo del Guanche. The material was collected on almost vertical

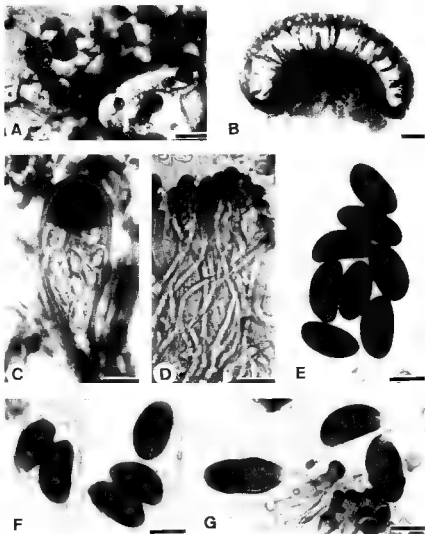


Fig. 1 — *Buellia vouauxii* (holotypus). A, apothecia, on the thallus of *Rhizoplaca melanophthalma*. B, section of an apothecium. C, young ascus, after IKI. D, paraphyses. E, ascospores. F, ornamentation of the ascospores. G, germinating ascospores. Scale bars = 1 mm (A), 100 µm (B), 10 µm (C-G).

faces of volcanic rocks, together with other lichens and lichenicolous fungi. A probably undescribed *Cercidospora* species occurring on *Rh. chrysoleuca*, and two *Arthonia* species, *Arthonia* sp. on *Rh. melanophthalma*, and *Arthonia glaucomaria* (Nyl.) Nyl. on *Lecanora rupicola* (L.) Zahlbr., were also found in this locality.

Buellia vouauxii can be considered as a commensalistic fungus, because it enters into a stable relationship with its host, not producing discolourations nor malformations.

DISCUSSION

The genus *Buellia* is one of the richest in the *Physciaceae*, including ca. 400 species (Hawksworth *et al.* 1983). It has a cosmopolitan distribution and is still very poorly known in many parts of the world.

Most of the species of this genus are autonomous, but parasitism is not unusual in this group (Scheidegger 1993). Modern descriptions and keys for most of the lichenicolous species are provided by Hafellner (1979), Clauzade *et al.* (1989) and Scheidegger (1993). Many of these species are parasites only at initial stages of development, later developing their own thallus and becoming autonomous (e.g. *Buellia sequax* (Nyl.) Zahlbr., *Buellia uberio* Anzi). Some others, also lichenized (but normally with a quite small thallus), are parasites during their entire life cycle (e.g. *B. imshaugii* Haf., *B. miriquidica* Scheidegger). Until the discovery of *B. vouauxii*, the only non-lichenized species of *Buellia* known was *B. adjuncta* Th. Fr., a commensal of *Lecanora straminea* Wahlenb. ex Ach. (Hafellner 1979, Santesson 1984) and *Rinodina olivaceobrunnea* Dodge & Baker (Alstrup & Hawksworth 1990). In addition to their occurrence on different host species, *B. vouauxii* and *B. adjuncta* differ in several characters (tab. 1). The apothecia of *B. adjuncta* are very characteristic: they are only up to 0.5 mm wide and, except the oldest, are typically concave and have a thick proper margin (Hafellner & Poelt 1976). Those of *B. vouauxii* are bigger, up to 1 mm in diam., flat or convex, and the proper margin is thin or almost inconspicuous. The size of asci, ascospores and hymenium also differ in both species, being larger in *B. vouauxii*. A stronger ramification of the paraphyses has also been noted in the new species when it is compared with *B. adjuncta*.

Since several species formerly referred to the genus *Karschia* have been transferred to the genus *Buellia* (Hafellner 1979), it was initially suspected that *Karschia laeta* Gerber, a lichenicolous fungus reported on *R. chrysoleuca*, might be conspecific with *B. vouauxii*. The type of *K. laeta* is lost (Hafellner 1979), but according to a description given in Trotter (1972 : 477), this species has hyaline ascospores, and only up to 10.5 µm large. Considering that description, it seems obvious that *K. laeta* is not a species of *Buellia*. The almost globose apothecia, small and broad asci, and hyaline, 1-septate ascospores, with cells of different sizes, rather suggest an *Arthonia* species.

Tab. 1 — Diagnostic features for the separation of *B. vouauxii* and *B. adjuncta*.

	<i>Buellia vouauxii</i>	<i>Buellia adjuncta</i>
Apothecia	- 0.4-1 mm. - flat or slightly convex from the beginning.	- 0.25-0.5 mm. - concave, except when old.
Proper margin	- always thin. - brown.	- thick, except when old. - dark brown.
Hymenium	- 75-110 μ m.	- 70-80 μ m.
Hypothecium	- brown to dark brown.	- dark brown.
Paraphyses	- upper third strongly branched. - apices 4-7 μ m.	- upper third simple or weakly branched. - apices to 6 μ m.
Asci	- 50-65 x 15-18 μ m.	- 45-55 x 17-24 μ m.
Ascospores	- 16-20 x 7-10 μ m. - ornamented.	- 14-18 x 6-9 μ m. - ornamented.
Conidia	- bacilliform. - 4-5 x 1 μ m.	- not seen.
Hosts	- <i>Rhizoplaca melanophthalma</i>	- <i>Lecanora straminea</i> - <i>Rinodina olivaceobrunnea</i>

Additional material examined : *Buellia adjuncta* Th. Fr. : Norway, Troms : Tromsøysund, Kvaløy, Skulsdjord, Rekvika. Near the seashore, on a large boulder often visited by birds, 15.VIII.1969, R. Santesson 20110. Fungi lichenicoli exicc. n° 7 (VAB-lich. 7602).

We are indebted to Prof. R. Santesson (Uppsala) and Dr. P. Diederich (Luxembourg) for providing us with material of *Buellia adjuncta*, and to Dr. Francisco Pando (Madrid) and Franco Bersan (Trieste) for supplying us with several bibliographic references.

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INTERESTING RECORDS OF LICHENS AND ALLIED FUNGI FROM THE WESTERN PYRENEES (FRANCE AND SPAIN)

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ABSTRACT — An annotated list of 101 lichens and allied fungi, mainly the result of the field meeting of the Bryological and Lichenological Society of the Netherlands in July 1992 to the western Pyrenees, is presented. Additional recent lichen records are mainly provided by the second author. For some species, notes on distribution, taxonomy and ecology are given. Twenty-two species are new to France and six are new to Spain. Most of the records mentioned below are new for the western Pyrenees.

RÉSUMÉ — Les auteurs dressent une liste annotée de 101 lichens et champignons lichénicoles, résultat des herborisations de la Société Bryologique et Lichénologique des Pays-Bas dans les Pyrénées occidentales (Juin 1992). Le deuxième auteur a ajouté des récoltes personnelles. Des notes de distribution, de taxonomie et d'écologie sont indiquées pour chaque taxon. Vingt deux espèces sont nouvelles pour la France et six pour l'Espagne. De nombreux taxons sont nouveaux pour les Pyrénées occidentales.

INTRODUCTION

The biennial summer field meeting of the 'Bryologische en Lichenologische Werkgroep der KNNV' (the Dutch Bryological and Lichenological Working group), was held from 20 — 30 July 1992, based, at Ste-Engrâce, 50 km SW of Pau (Pyrénées-Atlantiques, France). A group of five lichenologists collected c. 2500 samples; the most interesting records which were identified, are presented in the list below. Descriptive accounts of the localities visited and a complete species list will be published elsewhere.

Except for the last decade, papers dealing with the lichen flora of the western Pyrenees are extremely few. A list of more than 800 taxa, with mostly French collections are given by Vivant (1988). The Spanish part of the western Pyrenees has been investigated more intensely since 1986. The most comprehensive treatment is

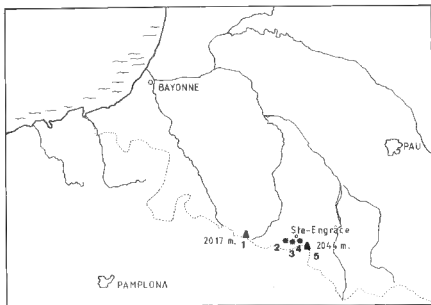


Fig. 1 — Location map of the five main sites visited by the Bryological and Lichenological Society of the Netherlands (June 1992) in the western Pyrenees. 1: Pic d'Orhy, 2: Gorges de Kakouëtta, 3: Gorges d'Ehujarré, 4: Arpidéko Ibarra, 5: Pic d'Arlas.

that by Etayo (1989). In the last few years, several lichenologists from Great Britain, Belgium, Luxemburg, France, Germany and Austria have visited the western Pyrenees. Some of their observations have been published already (e.g. Etayo *et al.* (1993), Houmeau & Roux (1991) and Sérusiaux (1993)). Large areas are still very insufficiently studied lichenologically. The aim of our meeting was to investigate the area of Ste-Engrâce. As this was an exploratory meeting it was decided to visit a wide range of habitats rather than to investigate a few intensively.

The area of Ste-Engrâce is famous for several impressive gorges. During one day, collections were made in one of the most important places, gorges de Kakouëtta. Near the entrance of this gorge, we found a rich vegetation of *Buxus sempervirens* with foliicolous lichens such as *Byssoloma subdiscordans*, *Fellhanera bouteillei*, *Porina hoehneliana*, *P. oxneri* and *Strigula smaragdula*; on trunks we found a.o. *Celothelium buxi*, *Porina heterospora* and *P. rosei* and on twigs *Bacidia laurocerasi*. Trunks of *Acer campestre* yielded *Lauderlindsaya acroglypta*. Nearly 2 km in from the entrance of the gorge we collected *Arthopyrenia carneobrunneola* from *Corylus*. Lichen growth on exposed rocks was scarce and dominated by *Lepraria* spp. Another site of great lichenological importance, which we visited for one day, is gorges d'Ehujarré. The E and W facing slopes were covered with *Buxus sempervirens*-wood, mixed with *Corylus*, *Fagus*, *Fraxinus* and deciduous *Quercus*.

Here we recorded the same foliicolous lichen species as from gorge de Kakouëtta. Additional foliicolous records are *Bacidina vasakii*, *Fellhanera nigra* and *Porina leptosperma*. The epiphytic macrolichen flora was luxuriant. We recorded *Loharia amplissima*, *L. pulmonaria* and *L. scrobiculata*, several *Leptogium* species and *Sticia* species. Noteworthy crustose lichen species encountered include *Arthonia didyma*, *Arthopyrenia punctiformis*, *Bacidina phacodes*, *Catinaria atropurpurea*, *Dimerella pineti*, *Eopyrenula avellanae*, *Lauderlindsaya acroglypta*, *Thelopsis rubella* and in abundance *Porina rosei*. Steep calcareous rock faces supported *Catillaria minuta*, *Clauzadea immersa*, *C. monticola*, *Collema auriforme* (also growing epiphytic), *Lecania cuprea*, *Protoblastenia calva* var. *sanguinea*, and *P. rupestris*.

The third and most eastern gorge we visited was Arpidéko Ibarra, where we investigated only the area near the entrance. Here we found mature *Fagus* trees with *Acer campestre* and *Crataegus*. Well-lit calcareous sandstone outcrops had a rather rich covering of lichens, including *Catillaria lenticularis*, *Collema auriforme* and *Lecania sylvestris*. Overhangs and very shaded crevices yielded *Lepraria lesdainii* and *Leproplaca chrysodeta*. On a trunk of a young *Acer*, *Anisomeridium nyssaegenum*, *Gyalideopsis anastomosans*, *Pachyphiale carneola* and *Strangospora delitescens* were found. *Dimerella pineti*, *Gyalecta truncigena*, *Lecidea ocelliformis*, *Ramonia chrysophaea* and *Thelopsis rubella* were recorded on *Crataegus* and *Bacidia assulata*, *Cetrelia olivetorum* (fertile), *Phyllopsora rosei* and *Rinodina efflorescens* were collected from *Fagus*.

Some old woodlands are important ecosystems in this part of the Pyrenees. One of the most interesting woodlands visited by us was forêt d'Issaux, near col de Labays. About ten years ago one of the members of the group had found *Usnea longissima* here, but we could not refind it during the field meeting. However some hundred meters from this locality, at the way to pic Soulaing we found *Usnea longissima* with a length up to 1.20 m, growing on *Abies* and *Fagus*. The western part of forêt d'Issaux holds a great diversity of species, but the biomass of both macro- and crustose lichens is not exceptionally high. Species encountered include *Absconditella lignicola*, *Arthonia leucopellaea*, *Micarea cinerea*, *M. peliocarpa*, *Schismatomma pericleum* and *Trapeliopsis pseudogranulosa*. Records from *Abies* are a.o. *Alectoria sarmentosa*, *Bryoria bicolor*, *Lecidea roseotincta*, *Lopadium disciforme*, *Thelopsis rubella*, *Trapelia corticola* and *Xylographa vitiligo*. Recently there is some decline of the lichen vegetation, caused by human influence.

Pic d'Arlas (2044 m) is the highest site we visited during our excursions. On SW exposed steep, slightly calcareous schist and sandstone outcrops, between 1950 and 2000 m, rich lichen communities are developed. Amongst *Acarospora impressula*, *Aspicilia candida*, *A. cernohorskyana*, *Cephalophysia leucospila*, *Lecanora intricata*, *Rimularia insularis* (on *Lecanora rupicola*), *Polysporina ferruginea* and *Sporastatia testudinea* we found extensive patches of *Protoparmelia cupreobadia*.

The second highest mountain top we visited is pic d'Orhy (2017 m) from which many records are mentioned by Vivant (1988). This mountain top was not particularly rich in lichens. But we made a long walk over the mountain ridge, so this

area provided a good variety of species. On a bird perching place we encountered an extensive colony of *Candelariella aurella*, *Physcia caesia* and *Xanthoria elegans* together with *Lecanora agarthiana*. Terricolous records are *Biatra tetramera*, *Catapyrenium cinereum*, *C. lachneum*, *C. pilosellum*, *C. squamulosum*, *Leptogium intermedium*, *Megaspora verrucosa*, *Mycobilimbia fissuriseda*, *M. hypnorum*, *M. lobulata* and *Toninia rosulata*. Most of the rock in this area supports a calcifuge flora with *Acarospora badioatra*, *Rhizocarpon atroflavescens*, *Thelidium decipiens*, *T. papulare* and *Verrucaria tristis*. But here we also found siliceous rocks with a.o. *Caloplaca arenaria*, *Lecanora gangaleoides*, *Polysporina simplex*.

Trees and old walls in the village of Ste-Engrâce were also examined. An unexpected lichen record in Ste-Engrâce was *Rinodina flavosoralifera* on *Salix* along a stream. It was found growing together with *Halecania viridescens*, *Lecanora strobilina*, *Pertusaria coccodes* and *Punctelia subrudecta*. The north wall of the church (twelfth century) with calcareous and non calcareous stonework supported a rich lichen flora; 30 taxa were discovered, including *Catillaria lenticularis*, *Collema fuscovirens*, *C. polycarpon*, *Diploschistes gypsaceus*, *Diplotomma epipolium*, *Lecania turicensis*, *Lecidella stigmataea*, *Leptogium schraderi*, *Psora lurida*, *Toninia aromatica* and *Toninia tumidula*.

The scarce lichen survey in this part of the Pyrenees means that many species are still unrecorded. This survey confirms the lichenological importance of the study area. The western Pyrenees contain some of the richest areas for lichens in France and Spain. From the 101 lichens and allied fungi, recorded below, 22 are new for the lichen flora of France, 6 are new to Spain and most of them are first recorded here from the Pyrenees.

During the excursions we have visited c. 35 localities, of which 5 main sites are given in fig. 1. Material of all taxa mentioned below, is deposited in the private herbaria of the authors. Species marked with * are new to France and with * new to Spain. Nomenclature mostly follows Purvis *et al.* (1992).

New and interesting records for France and Spain

* *Absconditella lignicola* Vězda & Pisút — FRANCE: Pyrénées-Atlantiques, forêt d'Issaux, col de Labays, sloping *Abies-Fagus* wood, on decorticated rotting standing trunk with *Calicium lenticulare*, *Chaenotheca brunneola*, *C. chrysocephala*, *Chaenothecopsis pusilla*. A second record is from base of *Abies*, 1350 m, 31-VII-1992, v.d.Boom 13051, 13087 & Breuss 8937 (hb. Etayo 5395) (conf. A. Vězda). In habitus it is similar to *A. pauxilla*, but the ascospores of *A. lignicola* are ellipsoid, 3-septate and 10-15 x 5-6 mm. Another species occurring in France, *Cryptodiscus pallidus*, is somewhat similar in habitus, but is not lichenized. *A. lignicola* was previously known only from the Czech Republic (Vězda & Pisút 1984) and Austria (Türk & Poelt 1993). New to France.

Acarospora badiofusca (Nyl.) Th. Fr. — FRANCE: Pyrénées-Atlantiques, 0.9 km NW of Port-Larrau, path to pic d'Orhy, abundantly growing on low sandstone outcrops, 1700 m, 3-VIII-1992, *v.d.Boom* 13390. Not mentioned by Vivant (1988).

Arthonia astroidestra Nyl. — FRANCE: Pyrénées-Atlantiques, Forêt communale de St-Pée-sur-Nivelle, St-Pée, on *Quercus robur*, 50 m, 6-III-1994, *Etayo* 12236. The species was known previously from Bretagne in France, so it is a **new record from the Pyrenees**.

Arthonia lapidicola (Taylor) Branth. & Rostrup — FRANCE: Pyrénées-Atlantiques, 0.9 km NW of Port-Larrau, path to pic d'Orhy, on low exposed sandstone outcrops, 1700 m, 3-VIII-1992, *v.d.Boom* 13379. SE of Ste-Engrâce, E of col de la Pierre — St-Martin, path to pic d'Arlas, calcareous outcrop, 1760 m, 1-VIII-1992, *v.d.Boom* 13145. SPAIN: Navarra, Valle del Roncal, Refugio de Belagua, Lakora, cave, 1440 m, 17-IX-1992, *Calvo & Etayo* 11620, 11639. *A. lapidicola* occurs on calcareous substrata, especially on small pebbles and sometimes overgrowing calcicolous lichens. It has been reported from the Mediterranean as *A. cf. epimela* (Roux *in litt.*) but *A. epimela* is a lichenicolous fungi living on epiphytic lichens. Not mentioned by Vivant (1988).

Arthonia leucopellaea (Ach.) Almq. — FRANCE: Pyrénées-Atlantiques, E of Ste-Engrâce, forêt d'Issaux, on decorticated rotting standing trunk, 1350 m, 31-VII-1992, *v.d.Boom* 13068 & *Breuss* 8933. Ste-Engrâce, col de Saucusse, common on *Abies*, 1300 m, *Printzen & Etayo* 5848. *Ibid.*, 31-I-1993, *Etayo* 2048. Ste-Engrâce, bois d'Arbouty, on *Abies*, 31-I-1993, *Etayo* 2052. Gave d'Issaux, forêt d'Issaux, near crossroads in D-341, on *Abies*, *Etayo* 0471. Besides these French records the species is present in several localities in northern Spain, especially on *Quercus robur* (*Etayo* 1989). Mentioned by Vivant (1988).

Arthonia muscigena Th. Fr. (syn.: *A. leucodontis* (Poelt & Döbblers) Coppins) — FRANCE: Pyrénées-Atlantiques, E of Ste-Engrâce, path to pic Soulaing, E sloping *Abies-Fagus* wood, on moss over bark, 1380 m, 31-VII-1992, *Breuss* 8973. Bois de St-Joseph, bryophytes on *Fagus*, 6-VII-1993, *Etayo s.n.* Ste-Engrâce, between col de Saucusse and Arette, bryophytes on *Abies*, 26-VI-1992, *Printzen & Etayo* 5399. Col Lizuniaga, c. 5 Km Bera, forêt de Sare, on bryophytes on *Quercus robur*, 5-III-1994, *Etayo* 12230. SPAIN: Navarra, Baraibar, S. Miguel de Aralar, 1 km near house, bryophytes on horizontal rock with *Lecania bryophila*, 800 m, *Breuss & Etayo* 11978. *Ibid.*, Oronoz-Mugaire, Señorío de Bértiz, on thallus of *Bacidia arceutina*, 400 m, 4-I-1994, *Etayo* 12152. *Ibid.*, Irurita, Sayoa, on *Fagus*, 930 m, 22-V-1994, *Etayo* 12336. **New to French Pyrenees.**

Arthopyrenia antecellans (Nyl.) Arnold — FRANCE: Pyrénées-Atlantiques, SE of Larrau, gorges d'Holarté, on *Fagus*, 400-450 m, 5-VIII-1992, *Breuss* 9183 (det. E. Sérusiaux). This species is common in oceanic woods in northern Spain (*Etayo* 1989). Mentioned by Vivant (1988).

* *Arthopyrenia carneobrunneola* Coppins — FRANCE: Pyrénées-Atlantiques, WSW of Ste-Engrâce, gorges de Kakouëtta, on *Corylus*, ca. 550 m, 28-VII-1992, *Breuss* 8832 (det. E. Sérusiaux). *Ibid.*, on *Sorbus aucuparia* branches, 17-VII-1991, *Diederich & Etayo* 1359. Ste-Engrâce, gorges d'Holzartè, *Acer* trunk, 5-VII-1993, *Etayo* 3346. *A. carneobrunneola* has only been recorded before from Great Britain and Ireland (Purvis *et al.* 1992). **New to continental Europe.**

Aspicilia cernohorskyana (Clauz. et Vězda) Roux — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, E of col de la Pierre-St-Martin, path to pic d'Arlas, on calcareous outcrops, 1760 m, 1-VIII-1992, *v.d.Boom* 13158 (det. A.M. Brand). Not mentioned by Vivant (1988).

* *Bacidia delicata* (Larbal. ex Leighton) Coppins — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, along path to gorges d'Ehujarré, *Sambucus*, 600m, 26-VII-1992, *v.d.Boom* 12686 (det. B.J. Coppins). Ste-Engrâce, near the school, *Sambucus*, 600 m, 6-VII-1993, *Etayo* 0669. Ste-Engrâce, between col de Saucusse and Arette, *Sambucus*, 23-VI-1992, *Printzen & Etayo* 5856, 5845. Forêt communale de St-Pée-sur-Nivelle, St-Pée, *Hedera helix*, 50 m, 6-III-1994, *Etayo* 1221. SPAIN: Navarra, Baraibar, S. Miguel de Aralar, *Sambucus*, c. 900 m, 15-X-1991, *Calvo & Etayo* 6271. *Ibid.*, Oronoz-Mugaire, Señorío de Bértiz, *Sambucus*, 400 m, 4-I-1994, *Etayo* 12086, 12148. Larger part of samples were collected on *Sambucus*. Associated species are *Bacidia friestiana*, *Lecania cyrtellina* and *Mucentina stigonemoides*. *B. delicata* is common in this part of the Pyrenees, but not recorded previously. **New to France.**

* *Bacidia fuscoviridis* (Anzi) Lettau — FRANCE: Pyrénées-Atlantiques, W of Tardets, forêt des Arbailles, *Fagus* wood with calcareous outcrops, on vertical shaded rock, 900 m, 29-VII-1992, *v.d.Boom* 12916 (hb. Etayo 11764). This sterile record with greyish irregularly cracked thallus and pale green soredia along the cracks is similar to the fertile records of the Benelux where this species is not rare (*v.d. Boom et al.* 1994). Probably the first record for meridional Europe. **New to France.**

Bacidia herbarum (Stizenb.) Arnold — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, E of col de la Pierre-St-Martin, path to pic d'Arlas, on plant debris among low calcareous outcrops, 1760 m, 1-VIII-1992, *Breuss* 8993.

Bacidia hemipolia (Nyl.) Malme — FRANCE: Pyrénées-Atlantiques, E of Ste-Engrâce, S edge of bois de Soudet, road to la Pierre-St-Martin, N sloping *Abies-Fagus* wood, on *Fagus*, 1400 m, 31-VII-1992, *v.d.Boom* 13019 (conf. B.J. Coppins).

* *Bacidia intermediella* Vězda — FRANCE: Pyrénées-Atlantiques, WSW of Ste-Engrâce, gorges de Kakouëtta, on *Sambucus*, without associated lichens, 530 m, 28-VII-1992, *v.d.Boom* 12838 (conf. A. Vězda). *Ibid.*, on *Ulmus glabra*, 8-VII-1993, *Etayo* 2575. This species was previously known only from Central Europe. **New to France.**

* *Bacidia viridescens* (Massal.) Norman — FRANCE: Pyrénées-Atlantiques, Ste-Engrâce, on wall of barn, 620 m, 30-VII-1992, *v.d.Boom* 12961 (conf. B.J. Coppins). Widely distributed in Europe, but **not recorded from France before** (Purvis *et al.* 1992).

Bacidina chlorotica (Nyl.) Vězda et Poelt — FRANCE: Pyrénées-Atlantiques, ENE of Ste-Engrâce, col de Ste-Gracie, *Fagus* wood, on wood of fence post, 1350 m, 4-VIII-1992, *v.d.Boom* 13433. A rare but possibly overlooked species in the Pyrenees, which is not rare in some parts of NW Europe. **New to Pyrenees.**

Bacidina cf. egenula (Nyl.) Vězda — FRANCE: Pyrénées-Atlantiques, Ste-Engrâce, churchyard, on concrete, 620m, 3-VIII-1992, *v.d.Boom* 13430. Thallus fine granular, granules c. 70 µm diam.; apothecia -0.6 mm diam., dark brown; exciple colourless, but upper part brown, K + purplish tinge; hypothecium brown; spores 30-45 x 1.5 µm. (conf. B.J. Coppins).

Bacidina vasakii (Vězda) Vězda — FRANCE: Pyrénées-Atlantiques, SW of Ste-Engrâce, gorges d'Ehujarré, on leaves of *Buxus*, ca. 650 m, 2-VIII-1992, Breuss 9104 (det. E. Sérusiaux). *Ibid.*, twigs and leaves of *Buxus*, 31-I-1993, *Etayo* 5787. SPAIN: Navarra, Usún, foz de Arbayún, twigs of *Buxus*, *Etayo* s.n. Within the *B. apihaica* group the thallus varies from leprose to isidiate. Here we include samples with well developed thalli of coralloid gonioecysts.

Biatora tetramera (de Not.) Coppins — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, E of col de la Pierre-St-Martin, path to pic d'Arlas, terricolous among low calcareous outcrops, 1760 m, 1-VIII-1992, *v.d.Boom* 13130. Widespread in Europe from Scandinavia and the British Isles to Greece (unpublished record in hb. *v.d.Boom*). Mentioned by Hafellner (1989) from Pyrénées-Atlantiques as *Mycobolimbia fusca*.

* *Calicium lenticulare* Ach. (syn.: *Calicium subquercinum* Asah.) — FRANCE: Pyrénées-Atlantiques, E of Ste-Engrâce, col de Labayas, forêt d'Issaux, E sloping wood, on *Abies*, 1350 m, 31-VII-1992, *v.d.Boom* 13040 & Breuss 8942. SPAIN: Navarra, Articuza, *Castanea sativa* wood, *Etayo* 5607. *Ibid.*, Oronoz-Mugaire, Señorío de Bértiz, *C. sativa* wood, 400 m, 4-I-1994, *Etayo* 12145. **First record from France.** This species is not rare in northern Spain.

* *Caloplaca chrysophthalma* Degel. — FRANCE: Pyrénées-Atlantiques, SW of Larrau, road to Port-de-Larrau, W of Cayolar d'Arratakoua, edge of sloping *Fagus* wood, on mature *Fagus*, 1200 m, 3-VIII-1992, *v.d.Boom* 13162 (det. U. Søchting). SPAIN: Navarra, Baraibar, *Fraxinus* base, c. 800 m, *Etayo* 5245. *Ibid.*, Baraibar, S. Miguel de Aralar, Altxueta, *Fagus* wood, 1200 m, 22-VII-1993, Breuss & *Etayo* 3381. *Ibid.*, S. Miguel de Aralar, near Santuario, *Fraxinus*, 1200 m, 22-VII-1993, Breuss & *Etayo* 3393. Abárzuza, 500 m road to Iranzu, *Quercus ilex* subsp. *ballota* (Desf.). Samp., 900 m, 12-X-1993, *Etayo* 3371. **Not recorded from France or Spain before.** Some Spanish samples are richly fructified.

Caloplaca herbidella (Hue) H. Magn. f. *denigrata* (Servit) H. Magn. (syn.: *Blastenia herbidella* f. *denigrata* Servit in Hedwigia 74: 148, 1934). — FRANCE: Pyrénées-Atlantiques, W of Tardets, forêt des Arbailles, *Fagus* wood with calcareous outcrops, S of source de la Bidouze, on mature *Fraxinus*, edge of *Fagus* wood, 720 m, 29-VII-1992, v.d.Boom 13064. SPAIN: Navarra, Valle del Roncal, Larra, on *Abies*, 1700 m, Etayo 3646. *C. herbidella* f. *denigrata* differs from *C. herbidella* s.str. in some respects: isidia darker greyish brown; apothecia concave to plane, disc rust orange with brownish tinge, margins flexuose, thick and blackened, inner exciple dark olive pigmented, darker towards the outer edge, 0.2-0.8 mm in diam.; pycnidia dark olive to black.

Caloplaca dolomiticola (Hue) Zahlbr. — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, col de la Pierre-St-Martin, path to pic d'Arlas, on limestone, 1760 m, 1-VIII-1992, Breuss 9003, 9043.

Catapyrenium cinereum (Pers.) Körber — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, col de la Pierre-St-Martin, path to pic d'Arlas, terricolous, 1760-1850 m, 1-VIII-1992, Breuss 8988, 9025. SW of Larrau, NW of Port-Larrau, path to pic d'Orhy, among low exposed sandstone outcrops, 1880 m, 3-VIII-1992, v.d.Boom 13152, 13174 & Breuss s.n. Not mentioned by Vivant (1988) nor by Houmeau & Roux (1991). A few records from the Pyrenees are cited by Breuss (1990).

Catapyrenium daedaleum (Krempelh.) B. Stein. — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, col de la Pierre-St-Martin, path to pic d'Arlas, terricolous, 1760 m, 1-VIII-1992, v.d.Boom 13139 & Breuss 8992. This species, previously not mentioned from the Pyrenees, has a mainly boreal-alpine distribution.

Catapyrenium lachneum (Ach.) R. Sant. — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, col de la Pierre-St-Martin, pic d'Arlas, terricolous, 1950 m, 1-VIII-1992, v.d.Boom 13209. SW of Larrau, NW of Port-Larrau, path to pic d'Orhy, among low exposed sandstone outcrops, 1700 m, 3-VIII-1992, v.d.Boom 13389. A strictly arctic-alpine species, so far rarely collected in the Pyrenees.

Catapyrenium pilosellum O. Breuss — FRANCE: Pyrénées-Atlantiques, SW of Larrau, NW of Port-de-Larrau, path to pic d'Orhy, among low exposed sandstone outcrops, 1880 m, 3-VIII-1992, v.d.Boom 13540. This species has its European range centred in the north-west and southern parts of the continent. Earlier records from the Pyrenees are listed in Breuss (1990).

Catapyrenium pyrenaicum Breuss & Etayo — FRANCE: Pyrénées-Atlantiques, W of Tardets, forêt des Arbailles, *Fagus* wood with calcareous outcrops, in crevices of shaded vertical surface, 900 m, 29-VII-1992, v.d.Boom 12892 & Breuss 8847. SPAIN: Navarra, alto de Lizarraga, 950 m, vertical wall of large cave, on bryophytes, Etayo 11548. *Ibid.*, Baraibar, S. Miguel de Aralar, calcareous stones, 1200 m, 22-VII-1993, Breuss & Etayo 11945. Second record for France. Previously collected from pic Atchuria by J. Vivant (Breuss & Etayo 1992); this collection was referred to as *Dermatocarpon velebiticum* Zahlbr. by Vivant (1988).

Catapyrenium rufescens (Ach.) Breuss — FRANCE: Pyrénées-Atlantiques, Ste-Engrâce, village, wall along street, on vertical surface, 600 m, 26-VII-1992, *v.d.Boom* 12717, 12718. Ste-Engrâce, NW of village, S slope with barn, acid outcrops and boulders, 680 m, 30-VII-1992, *Breuss* 8880.

Catapyrenium squamulosum (Ach.) Breuss — FRANCE: Pyrénées-Atlantiques, Ste-Engrâce, NW of village, S slope with barn, acid outcrops and boulders, 650 m, 30-VII-1992, *Breuss* 8879. SE of Ste-Engrâce, col de la Pierre-St-Martin, path to pic d'Arlas, terricolous, 1760 m, 1-VIII-1992, *Breuss* 9011. SW of Larrau, NW of Port-Larrau, path to pic d'Orhy, steep outcrop, on overhang, 1820-1880m, 3-VIII-1992, *v.d.Boom* 13391, 13396 & *Breuss* 9126, 9127. The most widespread species of the genus; according to the treatment by Breuss (1990) mostly included within *C. lachneum*.

* *Catapyrenium umbrinum* Breuss — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, col de la Pierre-St-Martin, path to pic d'Arlas, terricolous, 1760 m, 1-VIII-1992, *Breuss* 8990. Until now *C. umbrinum* has been known from Dalmatica, Italy and N. America (Breuss & McCune 1994). **New to France.**

Catillaria erysiboides (Nyl.) Th. Fr. — SPAIN: Navarra, Isaba, Larra, *Fagus* stump, mixed with *Catinaria atropurpurea* and *Bacidia beckhausii*, 1500 m, 3-VIII-1987, *Etayo* 4231 (conf. B.J. Coppins). Growing with *C. atropurpurea* which differs in larger spores with thicker walls and reddish brown to black apothecia.

Catillaria minuta (Massal.) Lettau — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, entrance of Arpidéko Ibarra, narrow gorge, on steep shaded outcrop, 720 m, 27-VII-1992, *v.d.Boom* 12777. W of Tardets, forêt des Arbailles, *Fagus* wood and calcareous outcrops, on shaded overhang, 900 m, 29-VII-1992, *v.d.Boom* 12932. SW of Ste-Engrâce, gorges d'Ehujarré, on vertical shaded outcrop, 710 m, 2-VIII-1992, *v.d.Boom* 13274. SPAIN: Navarra, Huici, vertical outcrops, 600 m, *Etayo* 10183. Baraibar, S. Miguel de Aralar, shaded outcrops, *Etayo* 10194, 10227. *Ibid.*, Aralar, Puterri, cave, *Etayo* 10284. *Ibid.*, Aralar, Ipusmeaka, chasm, 29-X-1991, *Etayo* 11208, 11384. *Ibid.*, Aralar, Ormazarreta, cave, 15-X-1991, *Etayo* 11390. Isaba, Larra, cave A-50, 1700 m, VIII-1992, *Etayo* 11688. S de Urbasa, Otxaportillo, vertical outcrops, 900 m, 29-III-1991, *Etayo* 11092. This species has been placed in *Catillaria* by Lettau (1912) although its characters correspond better with the genus *Lecania* than with *Catillaria*. Apothecia are biatorine-lecanorine, with a few algae in the inner lower part of the exciple, 0.2-0.3(-0.45) mm in diam.; asci probably *Bacidia*-type, paraphyses c. 1.5 mm wide, apices to 3 mm wide, without or with weakly yellowish pigment, spores 1-septate, with fine warted surface. An easily overlooked species from shaded limestone.

Catinaria montana (Nyl.) Vain. — FRANCE: Pyrénées-Atlantiques, SE of Larrau, gorges d'Holzarté, on bark, 400-450 m, 5-VIII-1992, *Breuss* 9177. Already mentioned by Kalb (1982) from Pyrénées-Atlantiques.

* *Celothelium buxi* (Steiner) Aguirre — FRANCE: Pyrénées-Atlantiques, WSW of Ste-Engrâce, gorges de Kakouëtta, on trunk of *Buxus*, 560 m, 28-VII-1992, *v.d.Boom* 12878. *Ibid.*, trunk of *Buxus*, Etayo s.n. Ste-Engrâce, gorges d'Holzarté, on *Fraxinus*, 5-VII-1993, *Etayo* 3158 (det. B. Aguirre). Previously known only from the type locality in the Caucasus Mountains from *Buxus* (Aguirre-Hudson 1991). Here we give the first occidental European records and a new phorophyte for this species: *Fraxinus*.

Cephalophysia leucospila (Anzi) Kilius & Scheidegger (syn.: *Lecidea ultima* Th. Fr.) — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, col de la Pierre-St-Martin, path to pic d'Arlas, steep sandstone outcrops, 1820-1950 m, 1-VIII-1992, *v.d.Boom* 13241, 13243, *Breuss* 9061. Not recorded by Vivant (1988).

Cladonia humilis (With.) Laundon — FRANCE: Pyrénées-Atlantiques, NE of Ste-Engrâce, col de la Serre, terricolous, 1440 m, 4-VIII-1992, *v.d.Boom* 13511. Not recorded by Vivant (1988).

Cladonia ochrochlora Flörke — FRANCE: Pyrénées-Atlantiques, ENE of Ste-Engrâce, col de Ste-Gracie, *Fagus* wood, on moss on *Fagus*, 1350 m, 4-VIII-1992, *Breuss* 9151. Not recorded by Vivant (1988).

Collema multipartitum Sm. — FRANCE: Pyrénées-Atlantiques, W of Tardets, forêt des Arbailles, *Fagus* wood with calcareous outcrops, S of source de la Bidouze, on shaded outcrop, growing together with *C. polycarpon*, 720 m, 29-VII-1992, *v.d.Boom* 12950. E of Ste-Engrâce, a small gorge, 600-650 m, 26-VII-1992, *Breuss* 8761. SPAIN: Navarra, Mendilaz, calcareous outcrops, c. 1000 m, *Etayo* 10244. Navarra, Baraibar, S. Miguel de Aralar, vertical outcrops, 1200 m, *Etayo* 11180.

Dermatocarpon leptophyllum (Ach.) Vain. — FRANCE: Pyrénées-Atlantiques, W of Tardets, forêt des Arbailles, *Fagus* wood and exposed calcareous outcrops, 900 m, 29-VII-1992, *Breuss* 8871. SE of Ste-Engrâce, col de la Pierre-St-Martin, path to pic d'Arlas, on exposed outcrop, 1760 m, 1-VIII-1992, *v.d.Boom* 12991. This species is known from northern Europe and the Alps. **First record from the Pyrenees.**

Eiglera flavida (Hepp) Hafellner — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, col de la Pierre-St-Martin, path to pic d'Arlas, on vertical shaded outcrop, 1820 m, 1-VIII-1992, *v.d.Boom* 13177, 13178. *Ibid.* 1760 m, *Breuss* 8984, 9001. SW of Larrau, NW of Port-Larrau, path to pic d'Orhy, low outcrops on NE slope, 1880m, 3-VIII-1992, *v.d.Boom* 13417. SPAIN: Navarra, puerto de Larrau, Otxagavia, calcareous schists, 1585 m, 6-VII-1993, *Etayo* 11882. Huesca, Borau, Las Blancas, calcareous outcrops, 2100 m, *Etayo* 10304.

* *Eopyrenula avellanae* Coppins — FRANCE: Pyrénées-Atlantiques, SW of Ste-Engrâce, gorges d'Ehujarré, on *Corylus*, 620 m, 2-VIII-1992, *v.d.Boom* 13264 (conf. B.J. Coppins). This is the **first record from outside Great Britain**. For description see Coppins *et al.* (1992).

Farnoldia jurana (Schaer.) Hertel — FRANCE: Pyrénées-Atlantiques, SW of Larrau, NW of Port-Larrau, path to pic d'Orhy, steep outcrop, 1880m, 3-VIII-1992, *Breuss* 9128. SPAIN: Navarra, Baraibar, S. Miguel de Aralar, shaded outcrop, c. 1000 m, 10-X-1987, *Etayo* 10211. Barranco de Belabarce, steep outcrop, 1100 m, 25-VII-1987, *Etayo* 10264. Isaba, Larra, exposed outcrop, 1750 m, 2-VIII-1987, *Etayo* 00332. Ibid., steep outcrop, 11-VII-1989, *Etayo* 10595, P.W. James, F. Rose & E. Sérusiaux.

Farnoldia jurana (Schaer.) Hertel var. *muverani* (Müll. Arg.) ined. (syn.: *Melanolechia jurana* var. *muverani* (Müll. Arg.) Hertel) — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, col de la Pierre-St-Martin, path to pic d'Arlas, on exposed outcrop, 1820 m, 1-VIII-1992, *Breuss* 9054. Previously known only from the Alps (Clauzade & Roux 1985).

* *Fuscidea pusilla* Tønsberg — SPAIN: Navarra, Oronoz-Mugaire, Señorío de Bértiz, *Alnus glutinosa*, 300 m, *Etayo* 6221 (det. P.W. James). Goizueta, collado Errekalko, shaded valley, young *Quercus robur*, *Etayo* 6311. Guipúzcoa, Pagoaga, on *Alnus glutinosa*, 1-VI-1991, *Etayo* 6096. Differs from *F. viridis* in having divaricatic acid instead of perlatolic. **First record from meridional Europe.** Previously known only from Scotland, Sweden & Norway (Tønsberg 1992).

Gyalideopsis anastomosans P. James & Vězda — FRANCE: Pyrénées-Atlantiques, Ste-Engrâce, near village, on *Castanea sativa*, 600 m, 30-VII-1992, *v.d.Boom* 12638. SE of Ste-Engrâce, entrance of Arpidéko Ibarra, on horizontal branch of dead *Acer campestre*, 720 m, 27-VII-1992, *v.d.Boom* 12770 & *Breuss* 8793. Ste-Engrâce, Arpidia, *Corylus*, 6-VII-1993, *Etayo* 1465. SPAIN: Navarra, Alduides, Quinto Real, *Fagus*, with *Normandina pulchella*, 850 m, 27-X-1993, *Etayo* 3464. All the records mentioned here are sterile. **For the first time recorded for the western Pyrenees**, where it seems to be a rare species.

Gyalideopsis muscicola P. James & Vězda — FRANCE: Pyrénées-Atlantiques, ENE of Ste-Engrâce, col de Ste-Gracie, *Fagus* wood, on moss on *Fagus*, 1350 m, 4-VIII-1992, *v.d.Boom* 13449. Found as a glaucous grey film, growing over mosses with characteristic dark hyphophores (apical flange and lateral projections). Mentioned in Vivant (1988) as *Gyalideopsis* cf. *muscicola*, but also mentioned for France by Diederich *et al.* (1991).

* *Halecania elaiza* (Nyl.) M. Mayrh. — SPAIN: Navarra, Baraibar, Sierra de Aralar, 1 Km from forest house, shaded outcrop in *Fagus* woodland, 800 m, 22-VII-1993, *Breuss* & *Etayo* 12219 (det. B.J. Coppins). The species was previously known only from eastern Europe.

*^o *Halecania viridescens* Coppins & P. James — FRANCE: Pyrénées-Atlantiques, Ste-Engrâce, on *Salix* along stream, 620 m, *v.d.Boom* 12965. Col Lizuniaga, 5 Km from Bera, forêt de Sare near the frontier, on *Quercus robur*, 5-III-1994, *Etayo* 12237. SPAIN: Navarra, N of Pamplona, Valle de Odieta, S of Lizaso, *Quercus robur* wood, on *Crataegus*, 500m, 12-VII-1993, *v.d.Boom* 14158, (hb. *Etayo* 2785). Oronoz-Mugaire, Señorío de Bértiz, on *Quercus robur*, 400 m, *Etayo* 12036, 12349. **These**

records are new for Meridional Europe, France and Spain, although it has already been collected by Diederich at Fontainebleau in France.

Hymenelia prevostii (Duby) Krempelh. — FRANCE: Pyrénées-Atlantiques, E of Ste-Engrâce, crossing near col de Suscousse, open place with scattered *Fagus* and calcareous outcrops, 1540 m, 31-VII-1992, *v.d.Boom* 13117. Thallus immersed, apothecia immersed in deep pits, pale pinkish, ascospores broadly ellipsoid, 25-27 x 16-19 µm. SPAIN: Navarra, Peña Anchòriz, calcareous outcrops, 31-I-1985, *Etayo* 0217. Barranco de Belabarce, vertical wall, 1100 m, 25-VII-1987, *Etayo* 10252. Baraiibar, S. Miguel de Aralar, Ormazarreta, steep outcrops, 1025 m, 15-X-1991, *Etayo* 11333. Alto de Lizarraga, calcareous walls, 1000 m, 21-IV-1992, *Etayo* 11564. Isaba, Larra, calcareous walls, 1700 m, *Etayo* 11719. Already known from southern Spain (mentioned in Roux (1978) as *Aspicilia prevostii*).

* *Hypocomyce praestabilis* (Nyl.) Timdal — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, col de la Pierre-St-Martin, path to pic d'Arlas, on conifer wood, 1760 m, 1-VIII-1992, *v.d.Boom* 13162, *Breuss* 9002. Closely related to *H. xanthococca* (Sommerf.) P. James et G. Schneider which, according to Timdal (1984), is a Fennoscandian species. **New to France.**

Hypogymnia vittata (Ach.) Parr. — FRANCE: Pyrénées-Atlantiques, ENE of Ste-Engrâce, col de Ste-Gracie, sloping *Fagus* wood along road, on *Fagus*, 1350 m, 4-VIII-1992, *v.d.Boom* 13447. E of Ste-Engrâce, S edge of bois de Soudet, road to la Pierre-St-Martin, N sloping *Abies-Fagus* wood, on *Fagus*, 1400 m, 31-VII-1992, *v.d.Boom* 13028.

Lauderlindsaya acroglypta (Norman) R. Sant. — FRANCE: Pyrénées-Atlantiques, WSW of Ste-Engrâce, gorges de Kakouëtta, on *Acer campestre*, ca. 550 m, 28-VII-1992, *v.d.Boom* 12828. Ste-Engrâce, path N of village, on *Fraxinus*, 680 m, 30-VII-1992, *v.d.Boom* 12977. SW of Ste-Engrâce, gorges d'Ehujarré, on *Corylus*, 710 m, 2-VIII-1992, *v.d.Boom* 13316. SPAIN: Navarra, Echauri, *Quercus ilex* subsp. *ballota* base, 960 m, 20-III-1985, *Etayo* 1811, 4112. Leoz, *Quercus faginea*, 875 m, 13-III-1988, *Etayo* 4017. The species seems not to be rare in supramediterranean *Quercus* woods. Recorded in Etayo (1989) as *Sphaerulina chlorococca* with its own thallus.

Lecania inundata (Hepp ex Körber) M. Mayrhofer — FRANCE: Pyrénées-Atlantiques, Ste-Engrâce, village, on vertical shaded surface of wall along road, on calcareous stone, 600 m, 30-VII-1992, *v.d.Boom* 12716. This species is widespread in Europe, known from Sweden to North Africa and from the British Isles in the west to Poland in the east. **New to French Pyrenees.**

Lecania turicensis (Hepp) Müll. Arg. — FRANCE: Pyrénées-Atlantiques, Ste-Engrâce, village, on shaded wall of romanesque church, 620 m, 3-VIII-1992, *v.d.Boom* 13428. NW of Ste-Engrâce, on shaded wall of barn, 620 m, 30-VII-1992, *v.d.Boom* 12984. The distribution area of this species is mainly central Europe and

it seems to be less common in western Europe. It is also known from the Canary Islands. **Previously not recorded from French Pyrenees.**

Lecania sylvestris (Arnold) Arnold — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, entrance of Arpidéko Ibarra, on shaded W facing outcrop, 720 m, 27-VII-1992, *v.d.Boom* 12754 & *Breuss* 8787. W of Tardets, forêt des Arbailles, along *Fagus* wood, shaded calcareous outcrops, on shaded surface, 900 m, 29-VII-1992, *v.d.Boom* 12813. SPAIN: Navarra, Astiz, calcareous outcrops, 610 m, 15-IX-1988, *Etayo* 10189. Baraibar, S. Miguel de Aralar, cave A-10, c. 900 m, 15-X-1991, *Etayo* 11280, 11356, 11357. S. Miguel de Aralar, Ormazarreta, cave, c. 900 m, 15-X-1991, *Etayo* 11348. Isaba, Larra, c. 2000 m, cave, IX-1992, *Etayo* 11785. An easily overlooked species which is widely distributed in Europe. Recorded in Spanish Pyrenees by Etayo, Echarri & Goicoechea (1990) from two localities.

Lecanora dispersoareolata (Schaer.) Lamy — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, E of col de la Pierre-St-Martin, pic d'Arlas, steep sandstone outcrops, 1950 m, 1-VIII-1992, *v.d.Boom* 13226, 13240 (det. H.T. Lumbsch), *Breuss* 9056, 9057, 9058. SPAIN: Huesca, Borau, Las Blancas, slightly calcareous sandstones, 2100 m, 5-VII-1989, *Etayo* 11028, 11065, 11947 (conf. H. Vänškä). The collections from France contain psoromic (abundant), usnic and compsoromic acid. Not mentioned by Vivant (1988).

Lecanora jamesii Laundon — FRANCE: Pyrénées-Atlantiques, Ste-Engrâce, village, on *Robinia* along stream and meadow, 600 m, 30-VII-1992, *v.d.Boom* 12639. SPAIN: Navarra, Enderlaza, on *Quercus robur*, 50 m, 31-V-1986, *Etayo* 2711. Landibar, on *Q. robur*, 100 m, 22-VI-1987, *Etayo* 2934. Araquil, way Madoz-Alli, *Q. robur*, 600 m, 22-VII-1993, *Etayo* 12252. All these samples are abundantly fertile. **New record for French Pyrenees.**

Lecidea doliformis* Coppins & P. James — SPAIN: Navarra, Goizueta, on rotting wood, I-VI-1991, *Etayo* 6061, 12218 (conf. B.J. Coppins). The species was so far known from S and W Britain (Purvis *et al.* 1992). It differs from British samples in the great proportion of greenish pigment in the pycnidial wall. **New to Spain.

Lecidea exigua Chaub. — FRANCE: Pyrénées-Atlantiques, Ste-Engrâce, SE of village, on *Castanea* and *Corylus* in wood. SW of Ste-Engrâce, gorges d'Ehujarré, on *Corylus*, 620 m, 2-VIII-1992, *v.d.Boom* 12814, 13547, 13538. Ste-Engrâce, Arpidia near village, *Corylus*, VII-1993, *Etayo* 0655. SPAIN: Navarra, valle del Baztán, Elizondo, *Quercus robur* branches, 250 m, 29-VI-1986, *Etayo* 1342. Oronoz-Mugaire, Señorío de Bértiz, *Fagus sylvatica* trunk, 300 m, 15-XII-1985, *Etayo* 1140. *Ibid.*, *Alnus glutinosa* branches, *Etayo* 3504. Iribas, *Corylus*, 650 m, 29-VIII-1987, *Etayo* 4019. Valle de la Ulzama, Elzaburu, *Q. robur* branches, 530 m, 20-II-1986, *Etayo* 1051. Zugarramurdi, *Laurus nobilis*, 210 m, 20-VI-1988, *Etayo* 5204. Arrayoz, *Q. robur* branches, 270 m, 29-VI-1986, *Etayo* 5470. Yanci, *Alnus glutinosa* branches, 200 m, 25-II-1986, *Etayo* 6310. Oronoz-Mugaire, Señorío de Bértiz, *Q. robur* branches, 250 m, 13-XI-1992, *Etayo* 3731. Valle de la Ulzama, Alcoz, *Q. robur* trunk, 560 m,

Etayo 3398. Not mentioned by Vivant (1988). Overlooked for its small size but common, especially on branches of deciduous trees in oceanic locations.

* *Lecidea roseotincta* Coppins & Tønsberg — FRANCE: Pyrénées-Atlantiques, E of Ste-Engrâce, col de Labayas, forêt d'Issaux, E sloping wood, on *Abies*, 1350 m, 31-VII-1992, *v.d.Boom 13053* (det. Ch. Printzen, conf. T. Tønsberg). The wine-red color of this species is very characteristic. The presence of psoromic acid has been confirmed by TLC. Previously known from North America and Scandinavia, so this is the first record for France.

Lecidea speirodes Nyl. — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, E of col de la Pierre-St-Martin, pic d'Arlas, steep outcrops, 1950 m, 1-VIII-1992, *Breuss 9051*. Only mentioned by Vivant (1988) from pic d'Orhy.

Lecidella viridans (Flotow) Körber — FRANCE: Pyrénées-Atlantiques, Ste-Engrâce, NW of village, on vertical shaded surface of acid outcrops on S exposed slope, 680 m, 30-VII-1992, *v.d.Boom 12987* (det. A.M. Brand). A probably overlooked species, which is not mentioned by Vivant (1988).

Lepraria lesdainii (Hue) R.C. Harris — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, entrance of Arpidéko Ibarra, on very shaded rock, underside overhang, 720 m, 27-VII-1992, *v.d.Boom 12767* & *Breuss 8826*. W of Tardets, forêt des Arbailles, calcareous outcrops near *Fagus* wood, on shaded rock, 900 m, 29-VII-1992, *v.d.Boom 12910*. Many records from Spanish caves will be published further on.

Leptogium burnetiae Dodge — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, entrance of Arpidéko Ibarra, on *Fagus*, 720 m, 27-VII-1992, *Breuss 8802*. W of Tardets, forêt des Arbailles, *Fagus* wood, on *Fagus*, 900 m, 29-VII-1992, *v.d.Boom 12922*. SW of Ste-Engrâce, gorges d'Ehujarré, on *Acer campestre* and *Corylus*, 650 m, 2-VIII-1992, *v.d.Boom 13268, 13270* & *Breuss 9078*. ENE of Ste-Engrâce, col de Ste-Gracie, sloping wood along road, on *Fagus*, 1350 m, 4-VIII-1992, *Breuss 9157*. Ste-Engrâce, col de Saucusse, on *Fagus*, 17-VII-1991, *Etayo 6073*. SPAIN: Navarra, Orbaiceta, bosque del Irati, on old *Fagus*, 30-VI-1987, 900 m, *Etayo 3030*. Isaba, Aztaparreta, on *Fagus*, fertile, 1500 m, 2-VIII-1987, *Etayo 3211*. Between Leiza and Huici, *Fraxinus excelsior*, 800 m, 23-VIII-1987, *Etayo 3509*. Barranco de Belabarce, base and roots of *Fagus*, 1100 m, 25-VII-1987, *Etayo 5034*. Huesca, valle de Ordesa, on *Fagus*, *Etayo 5440*. Very close to *L. saturninum* (Dicks.) Nyl., its status as different species is problematical.

Leptogium diffractum Krempelh. ex. Körber — FRANCE: Pyrénées-Atlantiques, W of Tardets, forêt des Arbailles, *Fagus* wood with calcareous outcrops, on vertical shaded rock, 900 m, 29-VII-1992, *v.d.Boom 12901* (hb. Etayo 11765) & *Breuss 8855*. Abundant and fertile. Mentioned by Vivant (1988) from vallée d'Aspe.

Leptogium intermedium (Arnold) Arnold — FRANCE: Pyrénées-Atlantiques, Ste-Engrâce, NW of village, on vertical shaded surface of acid outcrops on S exposed

slope, 680 m, 30-VII-1992, *Breuss* 8883. SE of Ste-Engrâce, E of col de la Pierre-St-Martin, along path to pic d'Arlas, steep sandstone outcrops, 1950 m, 1-VIII-1992, *v.d.Boom* 13138, 13191, *ibid.*, 1760 m, *Breuss* 9013. NW of Port-Larrau, path to pic d'Orhy, among low exposed sandstone outcrops, 1880 m, 3-VIII-1992, *v.d.Boom* 13406 (with apothecia). Part of the material verified by P.M. Jørgensen. Not mentioned by Vivant (1988).

Megalospora tuberculosa (Fée) Sipman — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, entrance of Arpidéko Ibarra, on *Fagus*, 850 m, 27-VII-1992, *v.d.Boom* 12809. W of Tardets, forêt des Arbailles, S of source de la Bidouze, on *Fraxinus*, ca. 700 m, 29-VII-1992, *v.d.Boom* 12949. forêt d'Issaux, col de Labays, sloping *Abies-Fagus* wood, on *Abies*, 1350 m, 31-VIII-1992, *v.d.Boom* 13065. SW of Larrau, road D26 to Port-Larrau, edge of sloping *Fagus* wood, on *Fagus*, 1200m, 3-VIII-1992, *v.d.Boom* 13340. The species is common in the Atlantic Pyrenees (both French and Spanish part), especially on old trunks of *Fagus* and *Quercus robur*. Sterile samples verified (TLC) by H.J.M. Sipman. It is not rarely found with apothecia. Records from Spain in Etayo (1989). Mentioned by Vivant (1988).

* *Micarea adnata* Coppins — FRANCE: Pyrénées-Atlantiques, Ste-Engrâce, col de Saucusse, *Abies* stump, forming large thallus together with *Icmadophila ericetorum*, 31-I-1993, *Etayo* 2069-2071. SPAIN: Navarra, Leiza, decorticated *Fagus*, 470 m, 30-IV-1987, *Etayo* 2337, 2728. Oronoz-Mugaie, Señorío de Bértiz, *Castanea* wood, 350 m, 1-XII-1986, *Etayo* 9110 (conf. B.J. Coppins). Articuza, *Castanea* wood, 250 m, 20-X-1988, *Etayo* 4123. Valle de la Ulzama, Arraiz, *Quercus robur* (dead), c. 450 m, *Etayo* 5241. Orbaiceta, bosque del Irati, soft wood of *Abies*, 900 m, 24-VI-1992, *Etayo* 5872. Iribas, dead *Castanea*, 650 m, *Etayo* 3724. Recorded from several further localities in Etayo (1989) from Spain, where it is abundant on fallen trunks in oceanic woods. **New to France.**

Micarea cinerea (Schaer.) Hedl. — FRANCE: Pyrénées-Atlantiques, E of Ste-Engrâce, forêt d'Issaux, near col de Labayas, *Abies-Fagus* wood, on decorticated rotting trunk, 1350 m, 31-VII-1992, *v.d.Boom* 13057 & *Breuss* 8949 (det. B.J. Coppins).

Mniacea jungermanniae (Nees ex Fr.) Boud. — FRANCE: Pyrénées-Atlantiques, bois d'Arbouty, on algae in clay, 31-I-1993, *Etayo* 11790. A non-lichenized fungus, normally living on leafy liverworts.

* *Mycobilimbia fissuriseda* (Poelt) Poelt & Hafellner — FRANCE: Pyrénées-Atlantiques, 1 km NW of Port-Larrau, path to pic d'Orhy, exposed sandstone outcrops, on E slope, in crevices on low outcrops, 1700 m, 3-VIII-1992, *v.d.Boom* 13355, *ibid.*, 1880 m, *v.d.Boom* 13395 (det. E. Timdal). SPAIN: Navarra, Puerto de Larrau, Ochagavía, near the frontier area, crevices on calcareous schists, 1585 m, 6-VII-1993, *Etayo* 11884. Distributed in northern Norway, Novaya Zemlya and Central Europe, mainly on calciferous rock at altitudes ranging from 1600 to 2850 m (Timdal 1992). **New to France and Spain.**

Mycoporum quercus (Massal.) Müll. Arg. — FRANCE: Pyrénées-Atlantiques, SW of Ste-Engrâce, gorges d'Ehujarré, on twigs of *Quercus*, 660 m, 2-VIII-1992, *v.d.Boom* 13299. This non-lichenized fungus is not mentioned by Vivant (1988).

Omphalina ericetorum (Fr.) M. Lange ex H. Bigelow — FRANCE: Pyrénées-Atlantiques, E of Ste-Engrâce, forêt d'Issaux, near col de Labayas, on rotting wood, 1350 m, 31-VII-1992, *Breuss* 8939. Bois de St. Joseph, on rotting *Fagus* wood, VII-1993, *Etayo* 1476. SPAIN: Navarra, valle de Bertizarana, way Elizondo-Bearzun, Km 5, schist wall, 400 m, 22-V-1994, *Etayo* 12333. These samples were fructified.

* *Phaeophyscia insignis* (Mereschk.) Moberg — FRANCE: Pyrénées-Atlantiques, E of Ste-Engrâce, small gorge, on trunk, 600-650 m, 26-VII-1992, *Breuss* 8751 (conf. R. Moberg). Ste-Engrâce, path NW of village, on *Fraxinus*, 680 m, 30-VII-1992, *Breuss* 8905. This is a first record from France.

* *Placidiopsis pseudocinerea* Breuss — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, col de la Pierre-St-Martin, path to pic d'Arlas, 1750 m, 1-VIII-1992, *Breuss* 9020. *P. pseudocinerea* has a wide arctic-alpine distribution, but is rather infrequent and can easily be confused with *Catapyrenium cinereum*. First record from France.

Placopyrenium trachyticum (Hazsl.) Breuss — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, E of col de la Pierre-St-Martin, along path to pic d'Arlas, calcareous outcrops, on low outcrop, 1760 m, 1-VIII-1992, *v.d.Boom* 13151.

Polysporina ferruginea (Lettau) M. Steiner — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, E of col de la Pierre-St-Martin, along path to pic d'Arlas, calcareous outcrops, on low outcrop, 1950 m, 1-VIII-1992, *Breuss* 9052. This species, which differs from *P. simplex* in its epilithic, brownish to rust red thallus is also known from scattered localities in the Alps.

Porina borveri (Trev.) Hawksw. & P. James — FRANCE: Pyrénées-Atlantiques, Ste-Engrâce, a small gorge near village, 26-VII-1992, c. 625 m, *Breuss* 8776 (conf. E. Sérusiaux). Ste-Engrâce, gorge de Kakouëtta, old *Corylus*, 31-I-1993, *Etayo* 5761. Forêt des Arbailles, shaded *Fagus sylvatica*, 26-VI-1992, *Printzen* & *Etayo* 0782. SPAIN: Guipúzcoa, Aya, on *Acer campestre*, 250 m, *Etayo* 5217. The var. *leptospora* (Nyl.) D. Hawksw. with narrow spores has been collected in one Spanish locality: Navarra, Usún, foz de Arbayún, mature *Ilex aquifolium*, c. 500 m, 7-V-1987, *Etayo* 6231.

* *Porina guaranitica* Malme (syn.: *Porina heterospora* (Fink) R.C. Harris) — FRANCE: Pyrénées-Atlantiques, WSW of Ste-Engrâce, gorges de Kakouëtta, on *Buxus*, 510 m, 28-VII-1992, *v.d.Boom* 12821. According to McCarthy (1993) the species is known from SW Ireland, Madeira, N and S America, N and S Africa. New to France.

Porina leptosperma Müll. Arg. — FRANCE: Pyrénées-Atlantiques, SW of Ste-Engrâce, gorges d'Ehujarré, on *Buxus* leaves, 650 m, 2-VIII-1992, *Breuss* 9083, 9109 (det. E. Sérusiaux). *Ibid.*, 1993, *Etayo* s.n. A pantropical foliicolous species, in Europe hitherto known only from SW France.

Protoblastenia calva (Dicks.) Zahlbr. var. *sanguinea* (Arnold) Roux — FRANCE: Pyrénées-Atlantiques, SW of Ste-Engrâce, gorges d'Ehujarré, on vertical shaded calcareous rock, 660 m, 2-VIII-1992, *v.d.Boom* 13277. SPAIN: Navarra, Isaba, Larra, in shaded calcareous outcrops, 1980 m, *Calvo & Etayo* 11691. Probably new to western Pyrenees.

Protoparmelia cupreobadia (Nyl.) Poelt — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, col de la Pierre-St-Martin, path to pic d'Arlas, 1750 m, 1-VIII-1992, *v.d.Boom* 13234, 13238. Known from the type locality (pic du Midi) and a few other localities in France but not mentioned from the western Pyrenees before (Poelt & Leuckert 1991).

* *Pyrenula occidentalis* (R.C. Harris) R.C. Harris — FRANCE: Pyrénées-Atlantiques, SW of Ste-Engrâce, gorges d'Ehujarré, on *Corylus*, 650 m, 2-VIII-1992, *v.d.Boom* 13289 & *Breuss* 9085, 9086, 9111. New to France.

Rhizocarpon atroflavescens Lynge (syn.: *R. pulverulentum* (Schaer.) Räs.) — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, col de la Pierre-St-Martin, path to pic d'Arlas, collected from slightly calcareous rocks, 1750 m, 1-VIII-1992, *Breuss* 9000. NW of Port-de-Larrau, path to pic d'Orhy, shaded steep slightly calcareous outcrop, 1700 m, 3-VIII-1992, *v.d.Boom* 13362. Mentioned in Vivant (1988) only from pic de Bizkarzé.

Rhizocarpon oederi (Weber) Körber — FRANCE: Pyrénées-Atlantiques, Ste-Engrâce, on wall along field, 600 m, 26-VII-1992, *v.d.Boom* 12674. Not mentioned by Vivant (1988). New to western Pyrenees.

Rinularia gibbosa (Ach.) Coppins, Hertel & Rambold — FRANCE: Pyrénées-Atlantiques, ENE of Ste-Engrâce, Col de Ste-Gracie, N exposed slope with acid outcrops and boulders, on boulder, 1350 m, 4-VIII-1992, *v.d.Boom* 13528 & *Breuss* 9172. Not mentioned by Vivant (1988).

Rinodina biloculata (Nyl.) Sheard — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, on *Corylus*, c. 600 m, 26-VII-1992, *v.d.Boom* 12697. SPAIN: Guipúzcoa, Pagoaga, on *Sambucus* branches, 250 m, 1-VI-1991, *Etayo* 6200. This species was first reported from the Spanish Pyrenees by Etayo (1989) and recently mentioned for French Pyrenees by Giralt *et al.* (1994).

Rinodina capensis Hampe in Massal. (syn.: *Rinodina corticola* (Arnold) Arnold) — FRANCE: Pyrénées-Atlantiques, E of Ste-Engrâce, S edge of bois de Soudet, N sloping *Abies-Fagus* wood, on *Abies*, 1400 m, 31-VII-1992, *v.d.Boom* 13011, 13034

(det. H. Mayrhofer). A montane species, distributed from the Alps to Mediterranean region. Some French and Spanish records have recently published in Giralt & Mayrhofer (1994).

Rinodina castanomelodes Mayrh. & Poelt — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, E of col de la Pierre-St-Martin, along path to pic d'Arlas, calcareous outcrops, on low outcrop, 1950 m, 1-VIII-1992, *Breuss* 9062 (det. H. Mayrhofer). A species with an arctic-alpine distribution. It occurs on calcareous rocks. Previously known from France as *R. castanomela* auct.

* ***Rinodina flavosoralifera*** Tønsberg — FRANCE: Pyrénées-Atlantiques, Ste-Engrâce, village, on *Salix* tree along stream, 620 m, 30-VII-1992, *v.d.Boom* 13545. (det. T. Tønsberg). This crustose lichen with yellowish green soralia contains artothelin and thiophanic acid (TLC). **First record from France.** *R. flavosoralifera* is known from Norway and England (Giralt *et al.* 1995).

Schismatomma pericleum (Ach.) Branth & Rostr. (syn.: *Schismatomma abietinum* Almqu.) — FRANCE: Pyrénées-Atlantiques, E of Ste-Engrâce, forêt d'Issaux, near col de Labayas, on decorticated rotting standing trunk, 1350 m, 31-VII-1992, *v.d.Boom* 13068. Ste-Engrâce, col de Saucusse, on *Abies*, 1300 m, 24-VI-1992, *Printzen & Etayo* 5848. SPAIN: Navarra, Isaba, Larra, shaded sides of old *Abies*, abundant, 1700 m, 17-VIII-1987, *Etayo* 3037, 3345. Orbaiceta, selva del Irati, rare on *Abies*, c. 900 m, 17-VII-1988, *Etayo* 4023. Not mentioned by Vivant (1988).

Scolicosporum curvatum Sérusiaux — SPAIN: Navarra, ENE of Lumbier, Gorge de Arbayún, SE side of Rio Salazar, 1.5 km from entrance, NW slope with *Buxus sempervirens*, on *Buxus* leaves, ca. 500m, 13-VII-1993, *v.d.Boom* 14181 & *Etayo* s.n. (Other records from Arbayún: hb. *Etayo* 5955, 6064, 6191, 6368, 3703 & 5173). FRANCE: Pyrénées-Atlantiques, gave d'Issaux, forêt d'Issaux, road D-341, *Abies* needles, VII-1993, *Etayo* 3399, 0650 & 1175. Ste-Engrâce, gorges d'Ehujarré, *Buxus* leaves, 18-VII-1991, *Diederich & Etayo* 6126. Ste-Engrâce, between col de Saucusse and Arette, near ski station, 23-VII-1992, *Printzen & Etayo* 3465. Col de Labays, *Abies* needles, 1350 m, 6-VII-1993, *Etayo* 2782. For description see Sérusiaux (1993).

Staurothele areolata (Ach.) Lettau (syn.: *S. clopima* auct.) — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, E of col de la Pierre-St-Martin, along path to pic d'Arlas, on low calcareous outcrops, 1950 m, 1-VIII-1992, *v.d.Boom* 13215 & *Breuss* 9053. Mentioned from two localities in French Pyrenees by Vivant (1988).

****Thelocarpon intermediellum*** Nyl. — SPAIN: Navarra, ENE of Roncesvalles, 6 km N of Orbaiceta, *Fagus* wood, open place with rotting standing trunk along stream, 1100 m, 14-VII-1993, *v.d.Boom* 14226 (hb. *Etayo* 0467). **First record from France and Spain.**

* ***Thelotrema subtile*** Tuck. — FRANCE: Pyrénées-Atlantiques, SW of Ste-Engrâce, gorges d'Ehujarré, on branches, 650 m, 2-VIII-1992, *Breuss* 9098. A mainly

subtropical species with only transversely septate spores. In Europe it was previously known only from the British Isles and Sweden, although it is common in Macronesia.

Toninia taurica (Szat.) Oxner — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, col de la Pierre-St-Martin, path to pic d'Arlas, 1750 m, I-VIII-1992, *Breuss* 9006. SPAIN: Navarra, Alto de Lizarraga, crevices in calcareous outcrops, 950 m, 18-IV-1992, *Etayo* 11554. Isaba, Larra, crevices in Karst, 1600 m, *Etayo* s.n. Not common in SW Europe (map in Timdal 1991).

Toninia verrucarioides (Nyl.) Timdal (syn.: *T. kolax* Poelt) — FRANCE: Pyrénées-Atlantiques, W of Tardets, forêt des Arbailles, on horizontal surface of calcareous outcrop, on thallus of *Placynthium nigrum*, 900 m, 29-VII-1992, *v.d.Boom* 12913. SPAIN: Navarra, valle del Roncal, foz de Mintxate, calcareous outcrops, *Etayo* 10250 (det. E. Timdal). Baraibar. S. Miguel de Aralar, on thallus of *P. nigrum*, *Etayo* 10559. Monte Sayoa, on *P. nigrum*, *Etayo* s.n. Alto de Lizarraga, on *P. subradiatum*, 900 m, 17-IV-1992, *Etayo* 11572. It was known from Spain, Navarra (Timdal 1991), but it was not mentioned from this part of the Pyrenees before.

Usnea longissima Ach. — FRANCE: Pyrénées-Atlantiques, forêt d'Issaux, path col de Labays, to pic Soulaing, *Abies-Fagus* wood, on *Abies* and *Fagus*, *v.d.Boom* 13106, 13107 & *Breuss* 8963 (hb. *Etayo* 5398). Ibid., 6-VII-1993, *Etayo* 3359. Also mentioned by Vivant (1988).

Verrucaria fuscula Nyl. — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, col de la Pierre-St-Martin, path to pic d'Arlas, 1760 m, I-VIII-1992, *Breuss* 9009. SPAIN: Navarra, Lecumberri, on *Aspicilia calcarea* on calcareous exposed outcrops, *Goicoechea* & *Etayo* 10172. Alto de Lizarraga, on *A. calcarea* on flagstones, 950 m, 18-IV-1992, *Etayo* 11522. A parasite on *A. calcarea* s.l. Its distinction from *V. compacta* is discussed by Breuss (1994). Usually not found above 1000 m in France, but known from higher altitudes (2000 m to 3000 m) in Iran and Afghanistan (Breuss 1994).

Xanthoria sorediata (Vain.) Poelt — FRANCE: Pyrénées-Atlantiques, SE of Ste-Engrâce, col de la Pierre-St-Martin, path to pic d'Arlas, 1760 m, I-VIII-1992, *Breuss* 8981. Close related to *X. elegans* from which it differs in its isidia-like propagules (Giralt *et al.* 1993).

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APORTACIONES AL CONOCIMIENTO DE LA BRIOFLORA URBANA ESPAÑOLA

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RESUMEN — De las especies briofíticas presentes en más de tres ciudades españolas del total de catorce estudiadas, se recopilan e interpretan los datos sobre todos aquellos rasgos genéticos, fisiológicos, estructurales y ecológicos que se considera influyen en la consecución de un briófito «tipo urbano», el cual se llega a identificar en doce especies «urbanícolas»: *Tortula muralis* Hedw., *Bryum bicolor* Dicks., *Funaria hygrometrica* Hedw., *Bryum capillare* Hedw., *Bryum argenteum* Hedw., *Barbula unguiculata* Hedw., *Grimmia pulvinata* (Hedw.) Sm., *Didymodon fallax* (Hedw.) Zander, *Didymodon vinealis* (Brid.) Zander, *Lunularia cruciata* (L.) Lindb., *Orthotrichum diaphanum* Brid. y *Pseudocrossidium hornschiianum* (K.F.Schultz) Zander. El perfil biológico de éstas queda definido por doce características que parecen ser las responsables de la adaptación de los briófitos al medio urbano: alta capacidad de propagación, posiblemente dotadas de flavonoides protectores, preferentemente dioicas, biotipo cespitoso humilde, pulviniforme o alfombrado, saxicasmófitas o terrícolas, basófilas, nitrófilas y con alta tolerancia a las sales, fotófilas, tolerantes al pisoteo, con mayor vigor y desarrollo bajo un aporte continuo de nutrientes, con numerosas adaptaciones a la xerofilia, con estrategia colonizadora, toxitolérantes o medianamente toxitolérantes al SO₂, soportando por lo menos 50-60 µg/m³.

ABSTRACT — We have studied all the bryophyte species that live in more than three out of fourteen Spanish cities. Here we present data on the genetic, physiological, structural and ecological characteristics that are thought to be relevant in defining «urban» bryophytes. These characteristics were present in 12 «urbaniculous species»: *Tortula muralis* Hedw., *Bryum bicolor* Dicks., *Funaria hygrometrica* Hedw., *Bryum capillare* Hedw., *Bryum argenteum* Hedw., *Barbula unguiculata* Hedw., *Grimmia pulvinata* (Hedw.) Sm., *Didymodon fallax* (Hedw.) Zander, *Didymodon vinealis* (Brid.) Zander, *Lunularia cruciata* (L.) Lindb., *Orthotrichum diaphanum* Brid. y *Pseudocrossidium hornschiianum* (K.F.Schultz) Zander. The features which seem responsible for the adaptation of the bryophytes to the urban environment are: high capacity for vegetative propagation, the presence of protective flavonoids, dioecia and growth forms with short turfs, cushions or mats. Regarding the habitats and their ecological conditions, they are saxichasmophytes or terricolous, basophilous, nitrophilous, photophilous and trampling-resisting. They show enhanced survival and luxuriance under a regime of nutrient flushing, many xerophytic adaptations, with a colonist life strategy and finally, they are toxitolerant or moderately toxitolerant to the SO₂, surviving in pollution levels of over 50-60 µg/m³.

INTRODUCCION

Los briófitos tienen una presencia mucho más relevante en las ciudades que en otros ecosistemas, ya que aquí ocupan microambientes casi exclusivos: existen multitud de microhábitats que por su tamaño o por el tipo de sustrato, únicamente pueden colonizarse por estas pequeñas criptógamas.

Como todos los organismos presentes en las ciudades, los briófitos se han visto afectados en mayor o menor medida por los efectos de la urbanización, que en ellos inciden según Taoda (1977), por:

- a. La naturaleza del sustrato.
- b. El clima y la polución del aire.
- c. El impacto humano.

Los sustratos que encuentran los briófitos en los medios urbanos se resumen en tres: suelo, rocas y árboles. El suelo desnudo es muy raro en la zona altamente urbanizada, siendo los alcorques y los pequeños jardines entre edificios los hábitats principales que se pueden colonizar; su pH suele ser 7-8. Los sustratos rocosos de la ciudad son las paredes de hormigón, de ladrillo y de los edificios. Y finalmente, la corteza de los árboles, más soleada, polvorienta y acidificada, es el tercer sustrato sobre el que pueden desarrollarse los musgos y las hepáticas.

En cuanto al clima y la polución del aire, no hay duda de que la gran sequía de las ciudades juega un papel en la desaparición de briófitos de las urbes, pero la conclusión general es que la contaminación es la principal causa de este hecho.

En relación con los impactos humanos, la urbanización ha eliminado la mayoría de los hábitats donde se podían desarrollar los briófitos, y los lugares adecuados que quedan, se encuentran sometidos a una presión antropógena muy elevada por el pisoteo continuo, el vandalismo, las labores de clareo, limpieza, fertilización, etc...

Los briófitos urbanos han sido especialmente estudiados en Japón, pero es difícil comparar sus resultados con los de las ciudades europeas, dada la enorme diferencia florística entre sus comunidades briofíticas. En España son catorce ciudades las estudiadas en este sentido del total de 50 capitales de provincia: Granada (Esteve & *al.* 1977), Catedral de Sevilla (Casas & Sáiz-Jiménez 1982), Palma de Mallorca (Fiol 1983), Toledo (Ballesteros & Ron 1985), Badajoz (Viera & Ron 1986), Avila (Vicente & *al.* 1986), Madrid (Mazimpaka & *al.* 1988), el estudio comparativo de estas cuatro últimas (Ron & *al.* 1987), Guadalajara (Ayala 1987), Segovia (Lara & Mazimpaka 1990 y Lara & *al.* 1991), Logroño (Soria & Ron 1990), Vitoria (Soria & *al.* 1992 y Heras & Soria 1990) y Cuenca (Mazimpaka & *al.* 1993), Burgos y Huesca (Soria 1993).

En este trabajo se han intentado analizar las características de los briófitos que parecen encontrarse bien adaptados a las ciudades españolas, reuniendo y examinando todos aquellos rasgos genéticos, fisiológicos, estructurales y ecológicos que se considera pueden influir en la consecución de un «tipo urbano».

METODOLOGIA

Se han seleccionado 83 táxones que son los que estaban presentes en más de tres ciudades españolas, del total de 14 estudiadas. De estas especies se han recopilado los datos bibliográficos sobre corología, ecología, germinación, anatomía, estomas, flavonoides, número cromosómico, multiplicación vegetativa, sexualidad, biotipo, querencia, posesión de caracteres xeromórficos, estrategia y respuesta al SO_2 .

RESULTADOS Y DISCUSION

Flora briológica

En el análisis de la flora, se puede decir que las familias dominantes en las ciudades españolas son: Pottiaceae, Brachytheciaceae, Bryaceae y Amblystegiaceae.

En cuanto a las especies, se han considerado las más frecuentes en los medios urbanos las que están en más de ocho ciudades, enumeradas según orden decreciente de aparición en las ciudades. Son las siguientes:

Tortula muralis Hedw., *Funaria hygrometrica* Hedw., *Bryum argenteum* Hedw., *Grimmia pulvinata* (Hedw.) Sm., *Didymodon vinealis* (Brid.) Zander, *Orthotrichum diaphanum* Brid., *Pseudocrossidium hornschiuchianum* (K.F.Schultz) Zander, *Bryum bicolor* Dicks., *Bryum capillare* Hedw., *Barbula unguiculata* Hedw., *Didymodon fallax* (Hedw.) Zander, *Lunularia cruciata* (L.) Lindb.

Entre las que colonizan las paredes de hormigón, ladrillo o muros de piedra en la ciudad, se encuentran fundamentalmente *Didymodon vinealis*, *Bryum capillare* y *Tortula muralis* que comparten los siguientes rasgos:

- a pesar de tener un amplio espectro de reacciones, se comportan en el medio urbano como estrictamente calcícolas amortiguando más eficazmente el efecto del SO_2 .

- presentan un biotipo cespitoso humilde que les permite protegerse mejor de cualquier acción mecánica tan habitual en la ciudad, refugiarse en pequeños nichos calcáreos y presentar una mínima exposición al SO_2 .

- se observan en ellas un gran número de adaptaciones a la xerofilia, como la posesión de filidios apretados o incurvados y revueltos cuando secos, de márgenes recurvados y células papilosas en algunos casos, etc... las cuales les permiten hacer frente a la sequía característica de la ciudad.

- tienen todas ellas un carácter colonizador por su gran capacidad de propagación, bien sea a través de la fragmentación del gametófito, bien mediante yemas protonemáticas o rizoidales. Y sin duda, se ven beneficiadas por la falta de competición con plantas vasculares.

- en el caso de *Bryum capillare*, se sabe que se desarrolla mejor con un flujo continuo de nutrientes, lo cual es típico en la ciudad (Gilbert 1968, 1970b).

— y finalmente, gracias a las características mencionadas y posiblemente a otras inherentes a las especies, se observa en diversos estudios de contaminación que se comportan como tolerantes o medianamente tolerantes a la polución debida al SO_2 (Bento Pereira & Sergio 1983; Gilbert 1968, 1970b, 1971; Johnsen & Søchting 1976; Nehira & Une 1980; Sergio & Sim-Sim 1985; Taoda 1981).

Bryum argenteum, *Bryum bicolor*, *Barbula unguiculata*, y *Funaria hygrometrica* colonizan fundamentalmente terrenos abandonados del centro de la ciudad. Es difícil encontrar suelos desnudos en las áreas altamente urbanizadas de las ciudades: sólo los alcorques y superficies entre los edificios. Las características compartidas por estos musgos son casi las mismas que las citadas para las especies de paredes, a las que se añaden otras propias del sustrato sobre el que crecen:

— a todas estas especies, al igual que ocurría con las de paredes, se las califica como colonizadoras, esto es, capaces de extenderse rápidamente por un territorio desnudo, creando el primer estadio de la sucesión e incluso formando el sustrato sobre el que se desarrollen en el futuro plantas vasculares. Esta cualidad se apoya sin duda en su alta capacidad reproductora. *Bryum argenteum*, *Bryum bicolor* y *Barbula unguiculata* comienzan dispersándose únicamente por yemas o fragmentos en el primer año y parte del segundo, y en los años siguientes, cuando ha descendido el nivel de nutrientes y ya hay cubierta vegetal, empiezan a desarrollar esporófitos (During 1979). Es muy probable que en el comienzo de esta rápida invasión del hábitat, estos musgos formen yemas en el protonema que inicien el proceso de dispersión. Piensa Whitehouse (1987), que esta posibilidad supone una gran ventaja para los primeros colonizadores de hábitats abiertos ya que se consigue un rápido esparcimiento. Hasta el momento, de las especies que ahora se están considerando, sólo se ha estudiado la presencia de yemas protonemáticas en *Barbula unguiculata*, pero es posible que se formen en todas las demás. En todas ellas, la velocidad de crecimiento es también muy rápida: las esporas germinan en muy poco tiempo y originan un protonema de vida muy corta que enseguida desarrolla los caulidios foliosos (Gilbert 1970b, 1971; Moyle Studlar & al. 1984). La falta de competición les permite extenderse rápidamente.

— al igual que ocurría con *Bryum capillare*, algunas de estas especies como *Bryum argenteum* y *Funaria hygrometrica* parecen tener mayor vigor y desarrollo bajo un aporte continuo de nutrientes; el flujo de polvo eutrófico de la ciudad cumple este papel, convirtiéndolas en componentes importantes de las comunidades briofíticas urbanas.

— se observa en estas especies una particular tolerancia al pisoteo. No sólo el biotipo y la gran capacidad de multiplicación vegetativa contribuyen a esto, sino que como afirma Bates (1935), la característica de filidios cortos, cóncavos y resistentes, que poseen, también condiciona en gran medida la resistencia.

— es de destacar que todas las especies que se están considerando son fotófilas, soportan altas intensidades de luz, lo que las hace idóneas para vivir en enclaves expuestos como son los suelos desnudos de las ciudades.

— se sabe que *Bryum argenteum* y *Funaria hygrometrica* son eurihalinas, y es posible que también lo sean las restantes, ya que el medio urbano es especialmente rico en sales solubles debido a la gran cantidad de polvo, hollín y depósitos de arena; incluso la lluvia está enriquecida en sales por la polución.

— y como última característica, condicionada en parte por todas las anteriores, se observa en estas especies una gran tolerancia a la contaminación industrial o urbana.

Grimmia pulvinata y *Orthotrichum diaphanum* son especies que muestran un comportamiento similar: según Gilbert (1970b), el factor que les permite mayor adaptación al medio urbano es el aumento de desarrollo y supervivencia bajo un régimen de flujo de nutrientes continuo como el de la ciudad; presentan también un elevado número de adaptaciones al ambiente xérico característico de ella y, finalmente, se las puede considerar entre medianamente toxitoleraentes y relativamente sensibles, soportando en general hasta 50-60 $\mu\text{g}/\text{m}^3$ de SO_2 .

Otra especie importante en las ciudades españolas es *Lunularia cruciata* la cual, según Gilbert (1970b, 1971) y Taoda (1977), parece beneficiarse de la falta de competición y del flujo de polvo eutrófico de las ciudades. Y sobre todo, opinan que su éxito urbano radica en su gran capacidad reproductiva: sus esporas y yemas germinan con gran rapidez, el protonema pasa rápidamente a un gametófito que tiene un crecimiento posterior muy acelerado. Todo ello hace que sea una hepática resistente a la acción del SO_2 .

Del comportamiento urbano de las dos especies que quedan: *Pseudocrossidium hornschiuchianum* y *Didymodon fallax* no se conoce mucho. Ambas parecen encontrarse en descampados, zonas de demolición de edificios o destrucción de terraplenes. Sus características les permiten la colonización de estos ambientes: pueden formar yemas en el protonema, resisten altas intensidades de luz, son fundamentalmente terrícolas y basófilas, con lo que pueden desarrollarse bien en estos medios con bastantes residuos orgánicos y con restos de materiales de construcción, los cuales, en su mayoría, son de naturaleza básica. También presentan adaptaciones a la xerofilia que sin duda les ayudan a soportar la pérdida de agua en estos enclaves tan expuestos.

Germinación y anatomía

Es muy bajo el número de datos que existe sobre estos aspectos para poder extrapolar algún tipo de conclusión en relación con posibles adaptaciones a este biotopo particular. Los principales estudios sobre germinación se han centrado en los patrones de desarrollo del protonema de diversas especies (Nehira 1983, 1988; Nishida 1978), mientras que los de anatomía han profundizado fundamentalmente en el estudio de los tejidos conductores, dada la gran importancia que supone el conocimiento de su estructura y composición desde el punto de vista filogenético (Héban 1977; Kawai 1976; Schreier 1980).

Estomas

Con los estomas ocurre lo contrario: sólo hay 10 táxones de los seleccionados sin datos sobre sus estomas. La información de la que se dispone, sin

embargo, es bastante pobre, ya que no existe una buena tipificación como la que hay en las plantas vasculares.

Tras el trabajo de Paton & Pearce (1957), la posibilidad de extraer alguna conclusión de tipo ecológico se hace muy lejana, ya que ni siquiera está claro el papel de los estomas en los briófitos. Para estos autores, las condiciones del hábitat no parece que influyan en la ausencia de estomas ni que ésta suponga un inconveniente en la lucha por la existencia. Parece que en las ciudades es bastante mayor el número de especies con pocos estomas, lo que Paton & Pearce (1957), consideran como posible adaptación a ambientes secos. No obstante, no hay que ser muy estrictos con este tipo de afirmaciones y hay que tener en cuenta la complejidad del proceso adaptativo de los briófitos y las posibles convergencias, ya que por ejemplo, en el grupo de «número bajo de estomas» de estos autores se encuentra *Eucladium verticillatum*, especie considerada higrófitas, con 6 estomas. Asimismo, en el grupo con más de 50 estomas, en teoría propio de ambientes húmedos, se encuentran *Bryum bicolor*, *Bryum argenteum*, *Bryum radiculosum*, *Funaria hygrometrica*, etc..., que están consideradas como xerófitas o xero-mesófitas.

Flavonoides

Se ha tenido en cuenta la presencia o ausencia de flavonoides en esta recopilación, por el posible significado adaptativo que puede tener la posesión de flavonoides como protección frente a depredadores (Kawasaki & Ohta 1976; Asakawa & al. 1980; Liao 1993), radiaciones, enfermedades (Banerjee & Sen 1979; Castaldo-Cobianchi & al. 1988; Huneck 1983; Spjut & al. 1986, 1992), etc... Sin embargo, se vuelve a tener el problema de la escasez de datos: sólo hay datos de un 10 % de los briófitos conocidos y además, la metodología utilizada no siempre ha sido la correcta, conduciendo a resultados erróneos. Sólo 15 del total de especies consideradas en este trabajo, tienen datos sobre la presencia de flavonoides. Cualquier conclusión es muy arriesgada con tal escasez de información; simplemente se puede destacar la presencia de flavonoides en especies tan «urbanas» como *Bryum argenteum*, *Bryum caespitium*, *Funaria hygrometrica* y *Lunularia cruciata* (Markham & Given 1988; Markham & Porter 1974; McClure & Miller 1967; Weitz & Ikan 1977).

Número cromosómico

A pesar de lo que la poliploidía pueda suponer de mecanismo adaptativo ligado a la estrategia vital se aprecia en estas especies urbanas una cierta tendencia a la diploidía, aunque algunas de las especies típicamente colonizadoras de las ciudades como: *Tortula muralis*, *Funaria hygrometrica*, *Bryum bicolor*, *Bryum capillare*, *Grimmia pulvinata*, etc..., si sean poliploides o diploides-poliploides (Fritsch 1982; Smith 1978). Con estos datos no puede extraerse ninguna conclusión clara que relacione el número cromosómico con la adaptación al medio urbano.

Multiplicación vegetativa

Según Longton y Schuster (1983), el tipo monoico es superior al dioico en la reproducción. En los medios urbanos, los briófitos dioicos parecen ser más abundantes que los monoicos, con lo que han de desarrollar muchos propágulos para extenderse por el medio. En este estudio de la brioflora urbana española, el número de táxones con y sin multiplicación vegetativa es casi el mismo. Sin embargo, en este último grupo están incluidos los pleurocárpicos, quienes, según Nehira & Nakagoshi (1990), en las ciudades presentan como patrón dispersivo, la regeneración desde los filidios o caulidios. Este sistema lo utiliza un gran número de briófitos, dada la potencialidad de las células de estas plantas.

Al contrario que en la germinación de las esporas, en la fragmentación la formación del protonema se ve frecuentemente omitida o se forma después de la aparición del gametófito, en su base, ya que mientras existan algunas células que proporcionen nutrientes a la planta en formación, el protonema no se hace necesario. No hay duda de que esto puede ser una ventaja considerable para la supervivencia de los briófitos en las ciudades, ya que así se evita la exposición del protonema, fase muy sensible al SO_2 y a otros agentes contaminantes. Además de la fragmentación, existe otro sistema de multiplicación vegetativa que pasa inadvertido en la herborización y posterior identificación; es el de la formación de yemas protonemáticas, cuya existencia detectó Whitehouse (1987) en numerosas especies y puede que también estén presentes en el grupo que se ha denominado «Sin multiplicación vegetativa». Whitehouse opina que es probable que para los primeros colonizadores de hábitats abiertos (muchos ambientes urbanos), la formación de yemas protonemáticas antes de la aparición de los gametófitos, suponga una importante ventaja al favorecer un rápido esparcimiento.

Resumiendo, si parece importante la multiplicación vegetativa en los briófitos de estas catorce ciudades españolas, ya que en casi todas las especies seleccionadas se han detectado, bien propágulos y yemas claramente observables, bien sistemas más enmascarados como la fragmentación o formación de yemas protonemáticas, que les ofrecen la posibilidad de dispersarse vegetativamente de una manera eficaz en estos medios urbanos.

Y finalmente, en relación con el tema, se observa que existe una correlación entre multiplicación vegetativa y sexualidad. De las especies seleccionadas, un 82% de las que presentaban mecanismos de propagación vegetativa, son dioicas, mientras que son monoicas un 18%.

Biotipo

En relación con los biotipos de las especies urbanas se ha observado, de mayor a menor proporción, la siguiente progresión:

Cespitoso humilde → Alfombrado → Pulviniforme → Anual →
Entramado → Cespitoso alto → Juláceo → Flabelforme.

Este es exactamente el mismo gradiente de disminución de la resistencia a la polución que muestra Gilbert (1970b). Los biotipos «Cespitoso humilde» y «Pulviniforme» exponen menos superficie a los posibles agentes contaminantes.

En la ciudad existen muchos enclaves abiertos y expuestos a la insolación que son colonizados por briófitos con biotipo cespitoso humilde, anual y pulviniforme fundamentalmente. Esto no hay duda que está conectado con el hecho de que la luz inhibe el alargamiento de los ejes y conduce a estas formas de crecimiento. Con estos biotipos son frecuentes los musgos con puntas pilíferas en los filidios, carácter relacionado con altas intensidades de luz, puesto que parece que se produce una reflexión de la radiación con la consecuente reducción de la pérdida de agua (Proctor 1979).

También los biotipos predominantes, cespitoso humilde, alfombrado y pulviniforme, presentan una mayor capacidad de retención de agua.

El biotipo alfombrado, el segundo en importancia en estas ciudades, ofrece posibilidades de cruzar pequeñas distancias a otros lugares más adecuados y generalmente aumenta la habilidad competitiva de las plantas, tan importante en un medio inhóspito como el de la ciudad (Warming 1884).

En el medio urbano, la tolerancia al pisoteo es un factor que permite una considerable ventaja adaptativa. Según Moyle Studlar & *al.* (1984), los céspedes humildes tienen una gran resistencia al pisoteo ya que presentan un crecimiento lento con las puntas de los caulidios protegidas por el resto de las plantas formadoras del césped y por ser empujados hacia dentro en el aplastamiento. En el biotipo alfombrado también los ápices de crecimiento se encuentran bastante protegidos.

Querencia

Sobre la querencia de estas especies urbanas hay que decir, en relación con el **factor agua**, que los xerófitos (46 %) son los predominantes en todas estas ciudades, lo cual era de esperar dado el carácter marcadamente mediterráneo de casi todas ellas, a lo que se puede sumar la condición xérica inherente a cualquier medio urbano.

Respecto al **factor luz**, la tendencia luminica de los briófitos urbanos es la fotofilia (40%). Lo que se viene diciendo del medio urbano en general, es que existe una reducción de la luz del 15-20% en comparación con el medio rural (Landsberg 1962, 1970). En estas catorce ciudades es posible que ni haya niveles demasiado elevados de polución ni la aglomeración de edificios sea tan grande como para provocar tal reducción de la luz que sólo permita la existencia de briófitos esciófilos. Por otra parte, hay que tener en cuenta las excepcionales características de luminosidad de las ciudades españolas en comparación con el resto de las europeas y americanas, que es donde se han hecho la mayoría de los estudios de este tipo. Además, en general, en las urbes españolas estudiadas los parques no son tan densos como los europeos, eliminando muchos hábitculos sombreados donde se pueden desarrollar briófitos esciófilos. En estos catorce medios urbanos, los ambientes que con más frecuencia se ofrecen a los musgos y hepáticas son los jardines más o menos expuestos, muros de construcción, descampados, medianas entre carreteras, caminos

en parques, etc..., todos ellos sometidos a altas intensidades de radiación luminica, por lo cual es lógico pensar que los fotófilos tengan más facilidades para invadir el medio.

En relación con las **propiedades químicas del sustrato**, los porcentajes más altos son los de los calcífilos (36%), indiferentes (30%) y basófilos (19%), dentro de los cuales se encuentran los nitrófilos. También en este caso las proporciones son las esperadas, dada la naturaleza básica de los suelos sobre los que se asientan la mayoría de las ciudades estudiadas. A esto se suma el hecho de que el suelo del medio urbano es en muchos casos el resultado de la acumulación de materiales de construcción (casi siempre de carácter básico) y de deyecciones y residuos ricos en nitrógeno, con lo que, aunque el sustrato original fuera ácido, casi todos los microhábitats de la ciudad tendrían características básicas. Por otra parte, son los basófilos en general los que pueden sobrevivir mejor en zonas contaminadas por SO_2 , ya que tienen la posibilidad de refugiarse en enclaves fuertemente calcáreos donde no se encuentra el ión HSO_3^- que es el componente más tóxico en este tipo de polución (Goossens 1976; Hoffman 1971).

En cuanto a los **hábitats**, el que presentaba mayor número de especies era el suelo húmedo y sombreado, que sin duda es el medio idóneo para el crecimiento de los briófitos y que en las ciudades se encuentra localizado en los parques y en jardines muy protegidos. En este hábitat se han encontrado tanto briófitos xerófitos como higróesciófilos. No obstante, le sigue muy de cerca el ambiente formado por los suelos secos y expuestos: alcorques, descampados, caminos, jardines abandonados, etc... Las proporciones de terrícolas y saxicasmófitos son prácticamente las mismas. Esto puede significar que los briófitos no se han distribuido principalmente en los hábitats presionadas por la influencia de la contaminación, sino por la disponibilidad de hábitáculos adecuados para su desarrollo, ya que según exponen Leblanc & Rao (1975), el gradiente ascendente en cuanto a sensibilidad al SO_2 es:

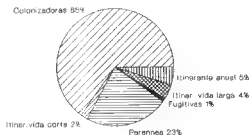
Terrícolas → Saxícolas → Epífitos

Caracteres xeromórficos

Lo que se puede extraer de los resultados en estas catorce ciudades, es que la inmensa mayoría de las especies que viven en ellas, concretamente un 92,7%, están dotadas, bien por la influencia del ambiente, bien por convergencia evolutiva, de una serie de estructuras xeromórficas que les ayudan a sobrevivir en el medio xérico urbano.

Estrategia vital

Siguiendo el criterio y terminología de During (1979) en relación con la estrategia vital de las especies urbanas, se ha resumido la proporción de cada grupo en el siguiente gráfico:



El primer aspecto digno de reseñar es el predominio de las especies de vida corta (colonizadoras, itinerantes anuales, itinerantes de vida corta y fugitivas). Esto concuerda perfectamente con el papel de los briófitos en el medio urbano: pioneros en las fases iniciales de la sucesión o en ambientes hostiles y sometidos a frecuentes perturbaciones, que son imposibles de colonizar por plantas vasculares. Se trata de musgos de pequeño tamaño que rápidamente ponen en marcha sus mecanismos reproductivos.

El porcentaje de especies perennes que se aprecia, representa aquellos briófitos instalados en los microhábitats más protegidos y más perdurables que se pueden encontrar en determinadas zonas de algunos parques de estas ciudades. Son musgos de mayor tamaño, con mayor capacidad de crecimiento y que no presentan mecanismos precoces de reproducción.

Respuesta al SO_2

Se dispone de datos bibliográficos en este sentido de 47 táxones (Barkman 1969; Bento-Pereira & Sergio 1983; Daly 1970; De Sloover & Leblanc 1970; Düll 1974; Gilbert 1968, 1970a, 1970b, 1971; Goossens 1976, 1979, 1980; Hoffman 1974; Johnsen & Sechting 1976; Leblanc 1961; Leblanc & De Sloover 1970; Leblanc & Rao 1973, 1975; Leblanc *et al.* 1972, 1974; Nash & Nash 1974; Nehira & Une 1980, 1981; Nordhorn-Richter & Düll 1982; Peicea 1973; Ranft & Dässler 1972; Rao & Leblanc 1967; Sergio 1981; Sergio & Bento-Pereira 1981; Sergio & Sim-Sim 1985; Stringer & Stringer 1974; Syrratt & Wanstall 1969; Takaoki & Mitani 1986; Taoda 1972, 1973a, 1973b, 1980, 1981; Türk & Wirth 1975; Umezu 1978; Winner & Bewley 1978a, 1978b, 1983; Winner *et al.* 1988), aunque algunos de ellos son contradictorios. Es de destacar que las especies con un carácter más tolerante se encuentran en un gran número de ciudades, con lo que parece desprenderse la idea de que estas especies toxitolerantes lo son por poseer una serie de características que les permiten, tanto soportar la acción del SO_2 o de otros contaminantes, como sobrellevar las otras condiciones de vida que les impone el medio urbano.

CONCLUSIONES

Tras este análisis global de la brioflora de las ciudades españolas que se encuentran estudiadas, se puede concluir que las 12 especies típicamente «urbanícolas» en ellas son: *Tortula muralis*, *Bryum bicolor*, *Funaria hygrometrica*, *Bryum capillare*, *Bryum argenteum*, *Pseudocrossidium hornschuchianum*, *Grimmia pulvinata*, *Barbula unguiculata*, *Didymodon vinealis*, *Didymodon fallax*, *Orthotrichum diaphanum* y *Lunularia cruciata*.

El perfil biológico de estas especies es el siguiente:

- Con alta capacidad de propagación.
- Posiblemente dotadas de flavonoides protectores.
- Preferentemente dioicas.
- Con biotipo cespitoso humilde, pulviniforme o alfombrado.
- Saxicasmófitas o terrícolas.
- Basófilas, nitrófilas y con una alta tolerancia a las sales.
- Fotófilas.
- Tolerantes al pisoteo.
- Con mayor vigor y desarrollo bajo un aporte continuo de nutrientes.
- Con numerosas adaptaciones a la xerofilia.
- Con estrategia colonizadora.
- Tóxitolerante o medianamente tóxitolerante al SO_2 , soportando por lo menos $50\text{-}60\text{ }\mu\text{g}/\text{m}^3$.

Todas estas cualidades pueden ser las responsables de la adaptación de los briófitos al medio urbano, si bien algunas deben de jugar un papel mucho más importante que otras en este proceso. Todo estudio sobre cada una de estas características contribuirá a ampliar el conocimiento sobre el papel ecológico de los briófitos en los medios urbanos y sobre su valor como bioindicadores del grado de urbanización, de calidad de biotopos y de contaminación de las ciudades para conseguir ciudades más limpias y más integradas en el medio natural.

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SOBRE LA PRESENCIA DE *LECANORA RUBICUNDA* BAGL. EN MARRUECOS

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RESUMEN — *Lecanora rubicunda* Bagl., un líquen epífito conocido anteriormente de Liguria, Cerdeña, Cataluña y Canarias, se menciona por vez primera en África continental, para lo cual se aportan dos localidades en el norte de Marruecos. Se incluye también una descripción completa de este taxon basada en nuestros ejemplares.

RESUMÉ — *Lecanora rubicunda* Bagl. lichen épiphyte, jusqu'ici connu seulement en Ligurie, Sardaigne, Catalogne et aux Canaries, est mentionné pour la première fois en Afrique continentale, dans deux localités du nord du Maroc. Nous donnons une description complète de ce taxon basée sur nos spécimens.

INTRODUCCION

Dentro de la con la línea de investigación sobre « Flora y vegetación líquénica del Norte de África », se han recolectado diferentes ejemplares de *Lecanora rubicunda* Bagl., un líquen conocido previamente de Italia (Nimis 1993), litoral de Cataluña (Boqueras & Gómez Bolea 1986, Giralte 1991 y Boqueras 1993) y Canarias (Lumsch & Feige 1992). Dado el interés tanto taxonómico como corológico de esta especie, se aporta una detallada descripción de la misma, realizada a partir de nuestros ejemplares, y se compara con los caracteres mencionados por Nimis & Poelt (1987) a partir del holotipo.

***Lecanora rubicunda* Bagl.**

Nuovo Giorn. Bot. Ital. 11: 74 (1879)

Talo crustáceo, epilítico, de color blanco o blanco-grisáceo, constituido por gránulos o pequeñas areolas poligonales, contiguas, finamente fisurado-areolado. En sección, provisto por una capa epinecral incolora o ligeramente parda, de 15-40 µm de grosor; córtex incoloro y poco diferenciado, de 15 µm de grosor; capa algal discontinua, de 50-70 µm de grosor, con algas protococcoides de 6-10 µm de diámetro; medula formada por una red laxa de hifas, incolora, con numerosos cristales.

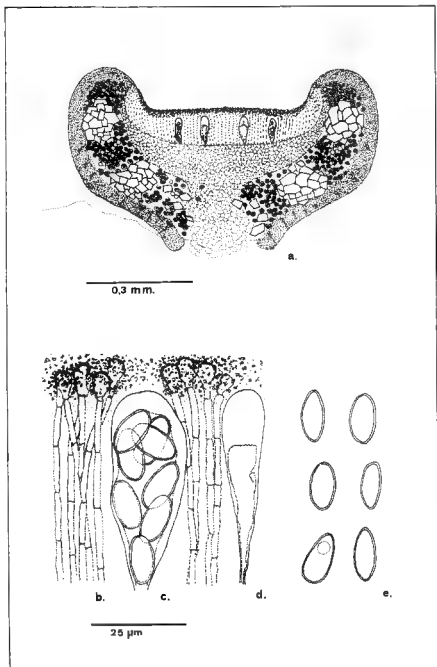


Fig. 1. — *Lecanora rubicunda*. a. Sección vertical del ascoma. b. Paráfisis. c. Asco maduro. d. Asco joven. e. Esporas.

Apotecios lecanorinos, circulares, de 0.5-1.5 mm de diámetro, numerosos, dispersos o confluentes por compresión mutua, sésiles. Disco plano o ligeramente convexo, de color pardo más o menos claro o pardo castaño, en ocasiones cubierto de una fina capa de pruina blanquecina. Margen talino del mismo color que el talo, entero, prominente y grueso, después delgado pero persistente. Córtex del margen en la parte superior de 20 μ m de grosor y hasta 35 μ m de grosor en la base. Anfitecio de tipo *Pulicaris* (Brodo 1984). Epitecio pardo claro, de 12 μ m de grosor, formado por gránulos gruesos, solubles en K e insolubles en N, dispuestos a nivel superficial y entre las paráfisis. Tecio incoloro, de 50-60 μ m de altura, insperso. Hipotecio hialino. Paráfisis septadas, coherentes, simples o con alguna ramificación, de 2 μ m de diámetro, no teñidas en el ápice y más o menos capitadas. **Ascos** claviformes, octosporados (raramente con menos de ocho esporas), de 40-50 \times 10-14 μ m. **Esporas** simples, incolores, elipsoidales, de 9-13 (14) \times (5) 6-8 μ m. Pared esporal de 1-1.2 μ m de grosor.

Reacciones químicas — Talo y margen talino K+ amarillo y a continuación rojo-pardo, P+ amarillo, KC+ pardo, C-. Disco K+ rojizo. La aplicación de K provoca, a nivel del epitecio y del córtex, la formación de cristales aciculares de color rojo intenso, visibles claramente al microscopio óptico. Contiene atranorina y ácido norstictico (Giralt 1991, Boqueras 1993).

Notas — Según Nimis & Poelt (1987) el tamaño de himenio es de aproximadamente de 80 μ m y las dimensiones de las ascósporas de 11-12 \times 5-6 μ m. En nuestros ejemplares el tamaño del himenio es menor, de sólo 50-60 μ m y las ascósporas son más anchas, dimensiones que concuerdan con las aportadas por Giralt (1991) y Boqueras (1993), de 9-13 \times (5) 6-8 μ m.

Hábitat — *Lecanora rubicunda* ha sido recolectada sobre un tronco joven de *Ficus carica* y gruesas ramas de *Pistacia lentiscus* L., sobre los que se encuentra acompañada de especies termófilas y esciófilas como *Lecidella elaeochroma* (Ach.) Choisy, *Bactrospora patellarioides* (Nyl.) Almq., *Arthonia melanophthalma* Duf., *Pertusaria heterochroa* (Müll. Arg.) Erichs. y *Schismatomma albocinctum* (Nyl.) Zahlbr.

Distribución — Taxon previamente conocido de la subregión Mediterránea Occidental (Liguria, Cerdeña, Cataluña) y de la subregión Macaronésica (Canarias). A éstas podemos añadir ahora dos localidades del litoral mediterráneo de Marruecos, ambas en el piso bioclimático termomediterráneo con ombroclima subhúmedo y seco, respectivamente.

Material estudiado — TETUAN: Residencial Al-Andalus (camping), 50 m, sobre *Ficus carica*, 9-4-1990, J. M. Egea y F. L. Alonso (MUB 22488).

DAR-M'TER: Carretera 608, entre Bouahmed y L-Jebha, a 20 km de esta última, 130 m, sobre *Pistacia lentiscus*, J. M. Egea y F. L. Alonso (MUB 22489).

AGRADECIMIENTOS — Este estudio se enmarca dentro del proyecto PB 93-1129-C02-01 financiado por la Dirección General de Investigación Científica y Técnica (Ministerio de Educación y Ciencia, España).

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PLAGIOCHILA BRITANNICA PATON (HEPATICAE) NEW TO SWITZERLAND AND CONTINENTAL EUROPE

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ABSTRACT. — *Plagiochila britannica*, a plant hitherto known only from the British Isles, is recorded from the Swiss Alps.

On a visit to the Klausenpass in Uri Canton, Switzerland, during a symposium on endangered bryophytes in Europe held at Zürich in September 1994, I collected several *Plagiochila* specimens from high altitude limestone outcrops in alpine grassland. Most of these proved to be *P. porelloides* (Torrey ex Nees) Lindenb. but one was determined as *P. britannica* Paton. This determination was subsequently verified by D.G. Long and J.A. Paton. *P. britannica* was growing among limestone rocks beside a stream on a north-facing slope, along with typical alpine calcicoles and more widespread species, including *Barbilophozia lycopodioides*, *Blepharostoma trichophyllum*, *Cephalozia bicuspidata*, *Conocephalum conicum*, *Jungermannia* spp., *Lophozia badensis*, *L. bantriensis*, *Scapania aequiloba*, *Ctenidium molluscum*, *Dichodontium pellucidum* and *Pseudoleskea incurvata* (nomenclature following Grolle 1983 for hepatics and Corley *et al.* 1981 with amendments by Corley & Crundwell 1991 for mosses).

The details are as follows :

Switzerland, Uri Canton : Chrächen, Klausenpass, 46°52' N 8°54' E, c. 2000m alt., among limestone rocks beside stream on north-facing slope in alpine grassland, 7 Sept. 1994, N.G. Hodgetts 3019 (Z).

P. britannica tends to be intermediate in size between *P. porelloides* and *P. asplenoides* (L.) Dum. The Swiss specimen, which is not fertile, resembles typical *P. britannica* collected in the UK in most respects. A shoot and some leaves are illustrated in fig 1. Although most of the leaves are considerably less toothed than shown in the illustration in the original description (Paton 1979), the drawings of *P. britannica* in Smith (1992) show leaves with few teeth, so the dentition of the leaf margin is clearly a variable character in this species. In general the marginal teeth of *P. britannica* tend to be fewer in number but slightly larger than those of *P. porelloides*. The leaf apex of *P. britannica* is frequently emarginate. The cells of the leaf and the stem cortex are significantly wider than those of *P. porelloides*, and the

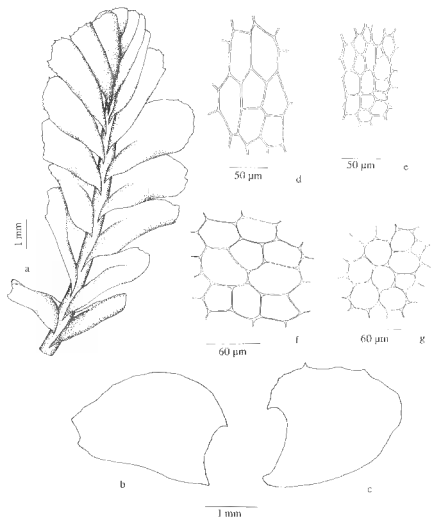


Fig. 1. — *Plagiochila britannica*. a. Sterile shoot — b & c. Leaf shape — d. Dorsal epidermal cells of stem — e. Dorsal epidermal cells of stem — f. Mid-leaf cells — g. Mid-leaf cells.

trigones tend to be less prominent. The cell size differences are the most reliable distinguishing characters. Indeed, in the small amount of Swiss material examined, the differences in cell size between the two species seem to be even more pronounced than in British material. These differences (using Swiss material of both species) are summarised in table 1 and illustrated in fig. 1. As mentioned by Paton (1979), leaf cell size is a variable character in this group of species, but the large cells of *P.*

britannica can always be detected on examination of the cells in several leaves from different shoots. Indeed, once one is familiar with the species, it is often possible to detect the large pellucid cells of *P. britannica* in the field. Refer to Paton (1979) for a detailed description of *P. britannica* and a discussion of the differences between *P. britannica* and the North American *P. arctica* Bryhn & Kaal. and its varieties.

	<i>P. britannica</i>	<i>P. porelloides</i>
Mid-leaf cell size	35-60(-82) μm long \times 30-53 μm wide	21-38(-46) μm long \times 21-38 μm wide
Width of dorsal epidermal cells of stem	23-42 μm	17-26 μm

Table 1. Differences in cell size between *P. britannica* and *P. porelloides*.

This is the first time *P. britannica* has been found outside Britain and Ireland and the first record from such a high altitude, although this is easily accounted for by the climate difference between Britain and Switzerland. In view of the large amount of apparently suitable habitat in the Alps and elsewhere in continental Europe, it is likely that the species will be found in other localities. Herbarium specimens of *P. porelloides* from limestone regions in continental Europe should also be checked.

ACKNOWLEDGEMENTS. — My thanks to E. Urmi and his colleagues at the Institut für Systematische Botanische at the University of Zürich for organising the field trip during the symposium on endangered bryophytes, and to D.G. Long and J.A. Paton for confirming the identity of the specimen and commenting on the draft of this note.

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ANALYSES BIBLIOGRAPHIQUES

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NASH III T.H., GRIES C. and ELIX J.A. — **A revision of the lichen genus *Xanthoparmelia* in South America.** *Bibliotheca Lichenologica* 1995, 56 : [1]-157[158], 26 fig., 2 tabl. [aut. : Dept. Bot., Arizona State Univ., Tempe, AZ 85287, USA ; éd. : Gebrüder Borntraeger, Johannestr. 3A, D-70176 Stuttgart ; ISBN 3-443-58035-1, prix : 80 DM].

Les espèces du genre foliacé *Xanthoparmelia* (Ascomycotina : Parmeliaceae) sont parmi les lichens les plus abondants sur les rochers ou le sol des régions arides ou semi-arides d'Amérique du Sud. Ils occupent des habitats très variés jusqu'à 4000m d'altitude. Leur couleur typiquement vert brillant ou vert jaune, due à la présence d'acide usnique dans le cortex supérieur, et leur surface inférieure avec des rhizines rendent le genre facilement reconnaissable. Mais pour mieux caractériser un spécimen, il faut considérer aussi les polysaccharides de la paroi cellulaire, et si possible, les caractères de l'apothécie. Sur la base de la richesse en espèce, le genre *Xanthoparmelia* est considéré comme un genre de l'Hémisphère Sud. Cependant la prépondérance de spécimens avec des propagules asexuées et la rareté de la reproduction sexuée indiquent que les *Xanthoparmelia* pourraient être originaire d'un autre continent, comme le Gondwanaland.

Après avoir donné l'historique, les caractères morphologiques, anatomiques, chimiques du genre, les auteurs décrivent 77 espèces de *Xanthoparmelia* présentes en Amérique du Sud en indiquant les synonymes, la chimie, l'écologie et les affinités taxonomiques de chaque espèce. Clé aux espèces. Description de 26 nouvelles espèces : *Xanthoparmelia arvidsonii* (Equateur), *X. bihemispherica* (Mexique et Pérou), *X. braziliensis* (Brésil et Paraguay), *X. echinocarpica* (Brésil), *X. hypostitica* (Brésil), *X. kashiwadani* (Pérou), *X. lopezii* (Venezuela), *X. mahuiana* (Argentine), *X. marcellii* (Brésil), *X. micropsoromica* (Pérou), *X. mobergii* (Pérou), *X. monastica* (Brésil et Pérou), *X. neocumberlandia* (Brésil), *X. neokalbii* (Uruguay), *X. osorioi* (Argentine et Uruguay), *X. pulvinaria* (Pérou), *X. pustulescens* (Argentine), *X. santessonii* (Pérou et Argentine), *X. scutariae* (Argentine), *X. sipmanii* (Venezuela, Brésil, Uruguay), *X. skottsbergiana* (Argentine, Chili), *X. subantarctica* (Argentine), *X. subthetica* (Brésil), *X. subulcerosa* (Equateur, Colombie, Venezuela), *X. uruguayensis* (Uruguay) et *X. xavieri* (Brésil). Une nouvelle combinaison est proposée : *X. crystallicola* (Kalb & Hale) (= *Pseudoparmelia*). Bibliographie (12p.), index taxonomique (10p.), index chimique (21/2p.).

KNOPH J.-G., SCHRÜFER K. & SIPMAN H.J.M. - **Studies in Lichenology with emphasis on chemotaxonomy, geography and phytochemistry.** *Festschrift Christian Leuckert.* *Bibliotheca Lichenologica* 1995, 57 : [1]-476, ill. (aut. : FU Berlin, Fachber. Biol. (FB 23), Inst. Syst. Bot. & Pflanzengeogr. (WE 2), Altensteinstrasse 6, D-14195 Berlin ; éd. : Gebrüder Borntraeger Verl., Johannesstr. 3A, D-70176 Stuttgart, ISBN 3-443-58036-X, prix : 180DM).

Ce volume a été réalisé en hommage à Christian LEUCKERT (né en 1930) dont le rôle dans l'étude des composés chimiques des lichens et de leur implication taxonomique est évoqué dans une courte notice. C. Leuckert s'intéresse principalement à la chimie des *Lecidella* et des

Lepraria ainsi qu'à la lichénoflore de la région de Berlin. 29 contributions concernant la taxonomie, la chimie et la répartition géographique des lichens composent ce volume, complété par un index des espèces et des genres de lichens et de champignons lichénicoles (pp. 459-476). Noter les éponymes créés à cette occasion : *Mycomicrothelia leuckertii* D. Hawksw. & J.C. David (île Maurice, p. 98) ; *Sclerococcum leuckertii* Diederich & P. Scholtz sur *Buellia aethulea* (Danemark, Suède, Allemagne, p. 114) ; *Lecidella leuckertiana* Knoph & Mies (Cap Vert, p. 301).

AHTI T., STENROOS S., and MARCELLI M.P. — *New species of Cladonia from Brazil* (pp. 9-18). Diagnoses de *Cladonia bahiana*, *C. fissidens*, *C. ibitipocae* et de *C. metaminata*, espèces nouvelles du Brésil. — APTRoot A., DIEDERICH P., SERUSIAUX E. and SIPMAN H.J.M. — *Lichens and lichenicolous fungi of Laing Island (Papua New Guinea)* (pp. 19-48). Liste de 63 lichens et champignons lichénicoles de Laing Island, dont plusieurs sont nouvelles pour la Papouasie-Nouvelle-Guinée. Nouvelles combinaisons : *Anisomeridium anisobolium* (Müll. Arg.) (= *Arthopyrenia*) et *A. consobrinum* (Nyl.) (= *Verrucaria*) ; nouv. espèces : *Arthonia arthonicola*, *Enterographa deslooveri*, *E. littoralis*, *Lecanographa laingiana*, *Polymyrium campylotheloides*, *Porina gaumae*. — ARNOLD N. und POELT J. — *Über Anthrachinon-Pigmente bei einige Arten der Flechten gattung Xanthoria, insbesondere aus der Verwandtschaft von Xanthoria elegans (Teloschistaceae)* (pp. 49-58). Anthraquinones des espèces du groupe *Xanthoria elegans* et des espèces de *Xanthoria* avec des diaspores isomorphes. — BRODO I.M. — *Notes on the lichen genus Placopsis (Ascomycotina, Trapeliaceae) in North America* (pp. 59-70). Notes sur les 3 *Placopsis* (dont *P. roseo-nigra* sp. nov.) présents en Amérique du Nord. Clé. — CASTELLO M. and NIMIS P.L. — *A critical revision of Antarctic lichens described by C.W. Dodge* (pp. 71-92). Liste commentée de 152 espèces antarctiques décrites par C.W. Dodge ; seules 31 espèces sont considérées comme valides. — DAVID J.C. and HAWSKWORTH D.L. — *Lichens of Mauritius I : some new species and records* (pp. 93-111). Liste commentée de 19 espèces nouvelles pour l'île Maurice, dont 5 sont nouvelles pour la science : *Cladonia mauritiana*, *Mycomicrothelia leuckertii*, *Ocellularia petrinensis*, *Pertusaria hymenelloides* et *P. muricata*. — DIEDERICH P. and SCHOLTZ P. — *New and interesting lichenicolous fungi. 5. - Sclerococcum leuckertii sp. nov. (Deuteromycotina)* (pp. 113-116). Diagnose de *Sclerococcum leuckertii* sp. nov. sur *Buellia aethulea*, récolté au Danemark, en Allemagne et en Suède. ELIX J.A. and NAIDU R. — *Identification of some minor dibenzofurans in the lichen Combea californica* (pp. 117-125). Identification de deux nouveaux dibenzofuranes. — GIRALT M. and MAYRHOFER H. — *Some corticolous and lignicolous species of the genus Rinodina (lichenized Ascomycetes, Physciaceae) lacking secondary lichen compounds and vegetative propagules in Southern Europe and adjacent regions* (pp. 127-160). Morphologie, anatomie, écologie et distribution de 12 espèces de *Rinodina*, sans produits secondaires et à propagules végétatives, dans le Sud de l'Europe. Descriptions et illustrations des ascospores de chaque taxon. Clé. Nouveaux synonymes ; noter *Rinodina ilimona* sp. nov. de Chypre et d'Espagne. — HAFELLNER J. and KALB K. — *Studies in Trichotheliales ordo novus* (pp. 161-186). Les espèces types des genres placés dans les Trichotheliaceae dans le dernier « Systema Ascomycetum » sont révisés. La famille des Trichotheliaceae est exclue des Pyrenulales et placée dans le nouvel ordre des Trichotheliales. Clé aux genres acceptés : *Clathroporina* Müll. Arg., *Porina* Müll. Arg. nom. cons. (1 comb. nouv.), *Pseudosagedia* (Müll. Arg.) Choisy (subgen. *Pseudosagedia* (groupes du *Porina aenea* et du *P. nitidula* ; 18 comb. nouv. et subgen. *Limosagedia* subgen. nov. (groupe du *Porina linearis* ; 4 comb. nouv.), *Trichothelium* Müll. Arg., et *Zamenhofia* Clauz. & C. Roux. En sont exclus les genres *Belonia* Koerb., *Clathroporinopsis* Choisy, *Dichasporis* Clements, *Diporina* Clements (1 comb. nouv.), *Poesia* Vezda, *Porinula* Vezda et *Spermatodium* Fée ex Trevisan. Aux côtés des rouge-*Sagedia* et brun-*Segestria* de Bachmann, les pigments jaune-*Porina* et violet-*Pseudosagedia* sont définis. Les termes « crystallostratum », « crystallocumuli » et « aerocliivi » sont introduits pour définir les structures de thalles de certains lichens crustacés tropicaux. — HANSEN E.S. — *The lichen flora of the Jørgen Bronlund fjord area, northern Greenland* (pp. 187-198). 86 esp. et 2 var. récoltées dans la région du fjord Jørgen Bronlund. Une attention

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SIPMAN H.J.M. and RAUS T. — **Lichen observations from Santorini** (Greece) (pp. 409-428). Liste commentée de 108 champignons lichénisés ou lichénicoles nouveaux pour l'archipel de Santorini, dont 37 sont nouveaux pour la Grèce. Comparaison des lichénoflores de laves d'âges différents. — TABACCHI R., TSOUPTAS G. and ALLEMAND P. — **Identification of triterpenes from lichens by tandem mass spectrometry (MS-MS)** (pp. 429-442). — WIRTH V. and HEKLAU M. — **Die epiphytischen Arten der Flechtengattungen *Lepraria* und *Leproloma* in Baden-Württemberg** (pp. 443-457). Analyses statistiques de la distribution altitudinale et du substrat.

GREVEN H.C. — ***Grimmia* Hedw. (Grimmiaceae, Musci) in Europe**. Leiden : Backhuys Publishers, 1995, [1]-160, 44 fig., 32 pl. coul. (aut. : Ibn-dlo, NL-6700 AA Wageningen ; éd. : P.O. Box 321, NL-2300 AH Leiden, ISBN 90-73348-38-2, prix : NLG 96.00).

Il y a plus de 60 ans, Leopold Loeske publiait « Monographie der Europäischen Grimmiaceen », ouvrage, in quarto, très détaillé sur les Grimmiaceae en Europe qui fait encore référence. S'inspirant de cette œuvre et tenant compte des récents travaux sur les *Grimmia*, H.C. Greven se restreint au seul genre *Grimmia*. Il ne reprend pas tous les détails fournis par Loeske, et propose un livre plus commode, dans son format et sa présentation, permettant une détermination plus rapide des espèces de ce genre. La classification du genre *Grimmia* est généralement basée sur le sporophyte ; malheureusement celui-ci est souvent absent, aussi Greven base sa clé sur les caractères du gamétophyte (trois groupes selon des critères tirés de la feuille).

Après avoir évoqué le port, l'habitat, la couleur, le mucron foliaire, la forme de la feuille, la nervure, l'aréolation, la reproduction, la capsule, l'auteur discute deux groupes taxonomiques complexes (le groupe du *Grimmia alpestris*, et le groupe du *Grimmia trichophylla*), montrant ainsi un grand degré de variation de certaines espèces et la difficulté de les délimiter. A partir des données de 13 pays européens, Greven établit la liste des espèces de *Grimmia* (14) à inscrire sur la liste rouge des espèces menacées.

Le corps du volume est constitué par le traitement spécifique. Pour chaque espèce, sont donnés les principaux synonymes, la description accompagnée d'une illustration [détail (figure dans le texte — on pourra regretter à ce sujet le parti pris de ne pas mettre d'échelle), port (photo en couleur)], l'écologie, la distribution, la discussion portant sur des points taxonomiques et/ou morphologiques, les spécimens examinés. Pour compléter utilement l'ouvrage : un index des taxons (pp. 145-149), une bibliographie (pp. 150-154) dont la présentation laisse à désirer (lignes non justifiées, citations non uniformisées (comme pour les espèces)), et deux appendices (liste et distribution mondiale de *Grimmia* Hedw. (pp. 155-158) et liste des personnes (avec leurs dates) citées dans le texte (pp. 159-160)).

GROLLE R. — **The Hepaticae and Anthocerotae of the East African Islands. An annotated catalogue**. *Bryophytorum Bibliotheca*, 1995, 48 : [1]-178, 3 fig. (aut. : Inst. Spezielle Bot., Friedrich-Schiller-Universität Jena, D-07749 Jena ; éd. : Gebr. Borntraeger, Johannesstr. 3A, D-70176 Stuttgart, ISBN 3-443-62020-5, prix : DM 80.00).

L'aire étudiée correspond à l'Afr3 de l'Index Muscorum, i.e. de Madagascar au Sud jusqu'aux Seychelles, région de l'Océan Indien comprenant de nombreuses petites îles, visitées dès 1804 par J.B.G.M. Bory de Saint-Vincent. Le catalogue est avant tout un registre des données publiées sur les hépatiques récoltées dans cette région. Toutefois l'auteur a vu bon de nombre de spécimens types et critiques, lui permettant d'en faire une évaluation, d'établir leur synonymie et leur distribution (en prenant souvent l'avis de ses collègues). Aussi, de nombreux

noms d'espèces ont pu être clarifiés comme syn. nov. et des déterminations ont pu être corrigées. 6 genres, qui ont été signalés dans les Iles d'Afrique de l'Est, sont ainsi rejetés de l'aire étudiée : *Alotiella* (Spruce) Schiffn., *Hygrolembidium* Schust., *Jubula* Dumort., *Lembidium* Mitt., *Megaceros* D. Campb. et *Spruceanthus* Verd.

Le corps de l'ouvrage est constitué de : Arrangement taxonomique des genres avec des commentaires sur certains genres (*Lophocolea*/Chiloscyphus, *Plagiochila*, *Lejeunea*/Rectolejeunea, *Metalejeunea*, *Microlejeunea*, *Archi-Lejeunea*/Archilejeunea) (pp. 21-23); liste alphabétique des espèces avec synonymie, distribution dans l'aire étudiée (et renvois bibliographiques), références aux illustrations (les synonymes sont catalogués dans le même ordre alphabétique avec renvoi au nom accepté) (pp. 21-139); espèces douteuses et exclues (pp. 140-158). Complètent ce catalogue : une bibliographie rigoureuse et très bien présentée (pp. 160-176), les liste des nouveaux noms, des nouveaux synonymes, des nouvelles typifications (p. 177-178). Nouveaux noms proposés : *Cheilojeunea compressa* (Herz.) comb. nov. (= *Strepsilejeunea*), *C. autoica* (Steph.) comb. nov. (= *Physocolea*), *Lejeunea brittoniae* (A. Evans) comb. nov. (= *Rectolejeunea*), *Metalejeunea* gen. nov. (type : *Jungermannia cucullata* Reinw. et al.), *M. cucullata* (Reinw. et al.) comb. nov. (= *Jungermannia*), *Riccardia nudiflora* (Steph.) (= *Aneura*), *R. ramosissima* (Steph.) comb. nov. (= *Aneura*).

L'ensemble de cet ouvrage est bien présenté ; il est toutefois dommage que ce genre de catalogue ne soit pas traité comme un dictionnaire avec des hauts de page significatifs. Il n'en demeure pas moins que ce travail sera un outil indispensable aux floristes travaillant sur cette région et les régions adjacentes.

DREHWALD U. — Epiphytische Pflanzengesellschaften in NO-Argentinien. *Dissertationes botanicae* 1995, 250 : [1]-175 [181], 29 tabl., 4 fig. dans le texte, 10 photos hors-texte (aut. : Wilhelmstrasse 48, D-35418 Buseck ; éd. : Gebr. Borntraeger Verl., Johannesstr. 3A, D-70176 Stuttgart, ISBN 3-443-64162-8, prix : DM 80.00).

Dans les provinces de Misiones et Corrientes (Argentine NE), 12 associations épiphytes et 3 associations épixyles (8 associations épiphytes et 1 association sur troncs en décomposition dans les forêts pluvieuses de la prov. de Misiones, et 5 épiphytes et 2 sur troncs en décomposition dans les forêts semi-toujours vertes de la prov. de Corrientes) ont été reconnues. L'écologie, la structure, la composition floristique, les aspects phytogéographiques des associations sont donnés avec leur synsystème. Toutes ces communautés sont nouvelles pour la science.

Dans les chapitres d'introduction l'aire étudiée est décrite (relief, climat, végétation), l'importance des épiphytes dans les forêts tropicales et la terminologie employée et l'histoire de la sociologie des épiphytes sont commentées. Dans les relevés phytosociologiques, 59 plantes vasculaires, 80 mousses, 62 hépatiques et 51 lichens ont été déterminés ; la majeure partie des espèces ont une distribution néotropicale, mais parmi les cryptogames il faut noter de nombreuses espèces à distribution pantropicale ou avec une disjonction afro-américaine. 14 espèces de mousses et 5 hépatiques sont nouvelles pour l'Argentine : *Chonecolea acutiloba*, *Frullania ericoides*, *Metzgeria psilocraspeda*, *M. convoluta*, *Plagiochila raddiana*, *Calypothecium duplicatum*, *Cyclodictyon varians*, *Erpodium biserialatum*, *Erythrodontium longisetum*, *Fissidens prionodes*, *Leucomium strumosum*, *Macromitrium nematosum*, *Neckeropsis pubstiana*, *Orthostichopsis tenuis*, *Pinnatella minuta*, *Porotrichum expansum*, *Prionodon densus*, *Syrrophodon parasiticus* var. *parasiticus*, *Tortula pagorum*.

La végétation épiphyte est différente d'une province à l'autre, principalement à cause du gradient de précipitation qui diminue d'est en ouest. L'écologie des épiphytes, notamment dans les zones tropicales, complète ce travail.

Bibliographie (pp. 153-169) ; liste des espèces (pp. 170-175).

INDEX DU TOME 16

Compilé par D. LAMY

Il ne figure que la première page de l'article dans lequel est cité le taxon. les nouveautés taxonomiques sont indiquées en gras. les taxons cités en synonymie ou comme basionymes sont indiqués par « syn. » ou « bas. » Lorsque le numéro de la page est suivi d'un nom de région, le taxon est considéré comme nouveau pour celle-ci (ex. *Acaulon triquetrum*, 289 Navarre).

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INSTRUCTIONS AUX AUTEURS

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